CHANGING TRENDS OF ELECTRIC POWER PRODUCTION IN THE WEST GROUP AREA OF THE PACIFIC NORTHWEST POWER POOL

by

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CHANGING TRENDS OF ELECTRIC POWER PRODUCTION IN THE WEST GROUP AREA OF THE PACIFIC NORTHWEST POWER POOL

ABSTRACT: The period between 1971 and 1992 will mark the transformation of the region's hydro based electrical system into one dependent on a mix of hydro and thermal generation. Through a review and compilation of current literature it has been determined that the program ushering in thermal generation is really an extension of cooperation developed between the region's utilities in the early 1940's. However, the success of this program depends on:

1) Maintaining construction schedules for new facilities;
2) continuing Federal support of the program; and
3) operating a relatively trouble free electrical system.

INTRODUCTION

With nearly all economically feasible hydro sites developed, meeting future power demands in the Pacific Northwest will require the incorporation of thermal plants into the predominately hydro-generating system. Under a plan designated as the Hydro-Thermal Power Program, hydro and thermal power plants will be integrated into a coordinated regional power system to:

1) Increase peaking generation capacity;

2) provide for additional base load; and

3) expand the capacity of existing transmission systems to accommodate increased power loads.

Specifically, this paper will demonstrate that thermal generated

electricity will be playing a major role in satisfying the energy needs of the area, and the introduction of thermal generation into the Pacific Northwest is the continuation of an extensive power network in which a degree of cooperation has been fostered between Federal and non-Federal electric utilities.

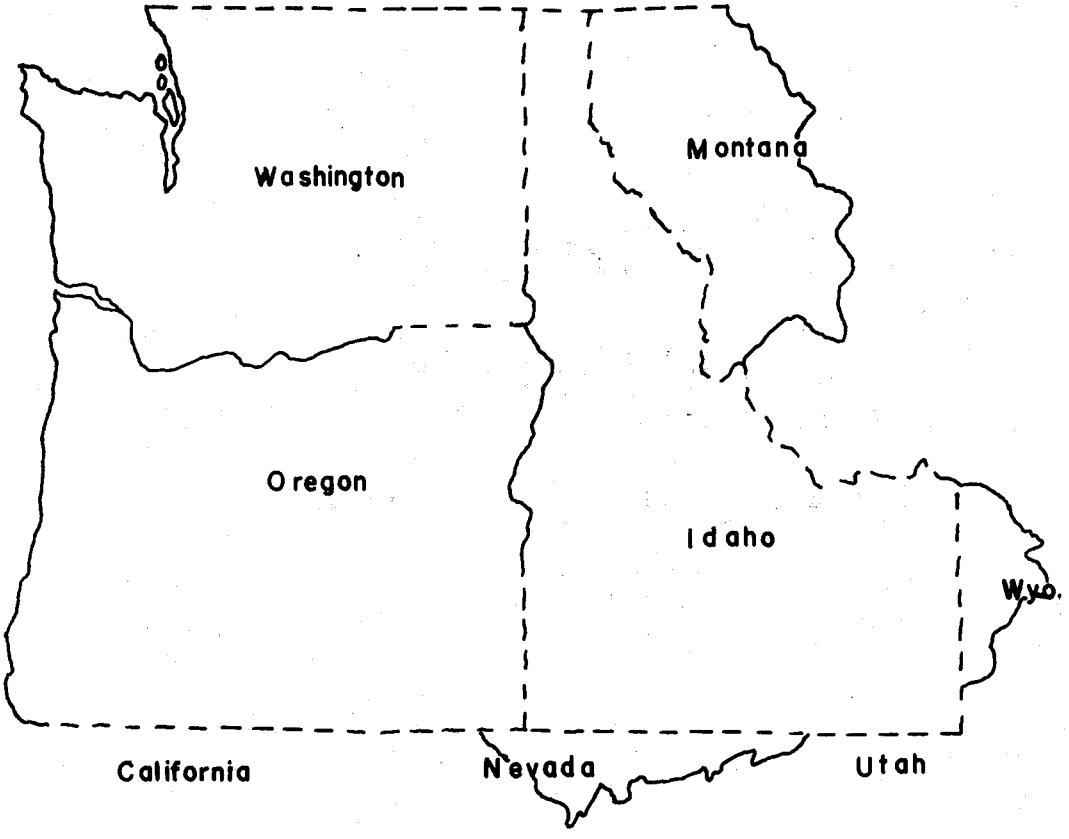
THE POWER REGION

The Pacific Northwest power system, hereafter referred to as the Pacific Northwest Power Pool, serves the United States drainage of the Columbia River and the coastal areas of Washington and Oregon (Illustration 1). This includes the states of Washington, Oregon, Idaho, Montana, west of the Continental Divide, plus small adjacent portions of California, Nevada, Utah and Wyoming. In terms of an operating system the Pool is divided into two groups.

The West Group Area covers approximately two-thirds of the United States drainage of the Columbia River and the coastal zones of Oregon and Washington (Illustration 2). This area covers 300,000 square miles and it contains over 6.5 million people.[1] The West Group is served by the Federally operated Bonneville Power Administration (BPA), four private companies, including Pacific Power and Light (PP&L), Puget Sound Power and Light, Portland General Electric (PGE), and Washington Water Power Company, and 104 publicly owned utilities. Connected by a system of high-voltage power lines, all West Group utilities operate and dispatch electric power as

Illustration 1

Geographical Area Served by the Pacific Northwest Power Pool

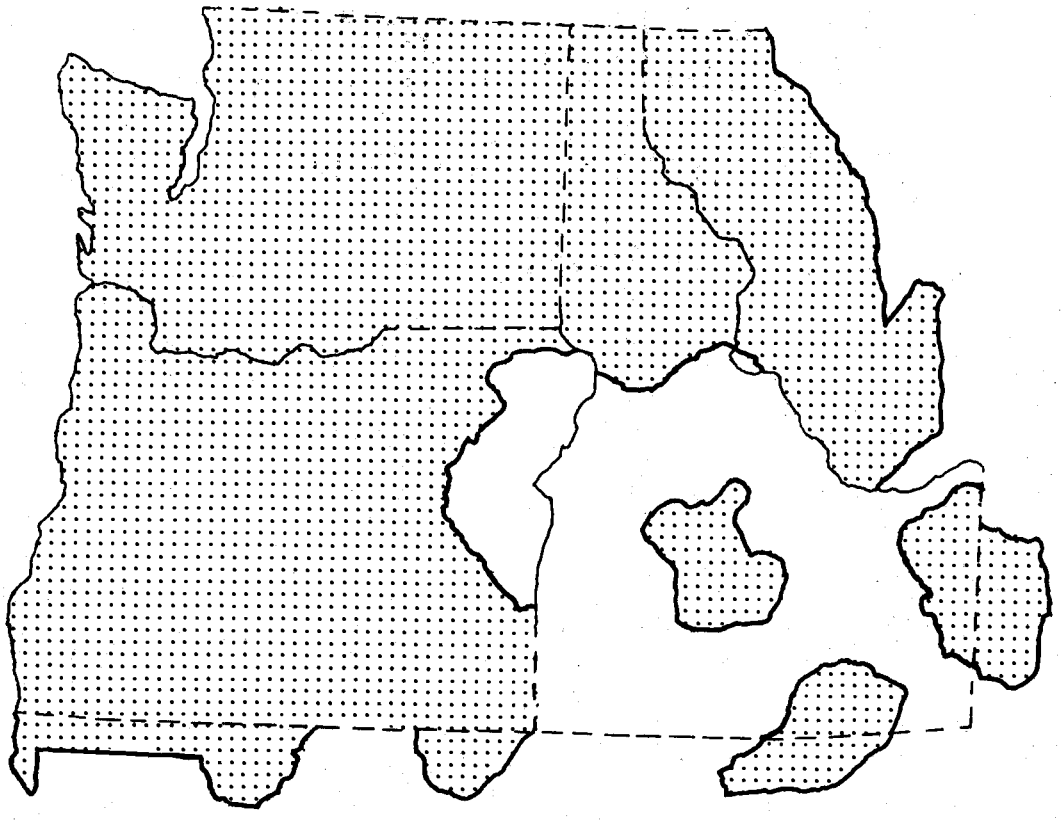


1" = 142 mi.

BPA 1971

Illustration 2

West Group Area of the Pacific Northwest Power Pool



West Group Area

1" = 142 mi.

BPA

1972

an integrated whole.[2] In addition all member utilities of the West Group purchase power from the BPA.

The East Group Area covers sparsely populated western Montana, southern Idaho, eastern Oregon and northern Utah. Operated along similar lines, it is dominated by large private utilities, such as Montana Power Company, Idaho Power Company and Utah Power Company. Unlike the situation in the West Group Area, East Group utilities do not purchase firm or peaking power from BPA.[3] Through primary exchange agreements electricity can be exchanged with BPA on a kilowatt for kilowatt basis when surplus energy is available or when an emergency or breakdown occurs. Though East and West Groups are interconnected both systems operate as two distinct entities. In this paper all discussion refers to the West Group.

COMPOSITION OF THE WEST GROUP AREA

In the West Group Area of the Pacific Northwest Power Pool electricity is generated and distributed by three utility groups.

The public sector consists of municipal, cooperative and public utility district (PUD) systems. The publicly run utility first appeared in 1882 when a municipal electric plant began operation in Tacoma, Washington.[4] Throughout the late 1800's and early 1900's other city governments with adequate capital acquired their own municipal systems including Seattle City Light and Eugene Water and Electric Board (EWEB). The cooperative utility first appeared in the early 1920's

when "co-ops" were established in southern Idaho to distribute power from the government's Minidoka Project. However, rapid growth in public power did not begin for another decade.[5]

Though initially encouraged in 1930 by the State of Washington's Public Utility District Act, public power became a reality through the intervention of the Federal Government. Due to the private sector's hesitancy in extending electrical service to rural areas, because the margin of profit was so small, Congress encouraged the formation of P. U. D.'s by the Rural Electrification Act of 1936.[6] The Act directed the newly created Rural Electrification Administration to provide low cost loans for the construction of publicly owned electric distribution facilities. Passage the following year of the Bonnevile Power Act ultimately guaranteed public utilities first priority to electricity produced at all Federal multi-purpose water projects in the Columbia Basin.

Privately owned utilities serving the region usually began as small, locally owned companies providing a number of utility services.[7] Beginning in 1885, small investor-owned firms eventually merged into such concerns as the Portland General Electric Company, Puget Sound Power and Light and the Washington Water Power Company. During the early 1900's regional private utilities became subsidiaries of larger holding companies.[8]

Prior to World War I holding companies in the gas and electric field were created to assist floundering utilities. Through their holding

companies private firms usually exchanged equipment or services for securities in the investor-owned utility. In this way, large systems under single managerial control were built-up to obtain the economic benefits of large-scale management and operation.[9] In the Pacific Northwest many private utilities were subsidiaries of holding companies. For example, Washington Water Power Company, Pacific Power and Light Company, Idaho Power Company and Montana Power Company were controlled by the Electric Bond and Share Company.[10] By the early thirties, the manipulative and price distorting tactics by some of the holding companies lead to their dismemberment. As a consequence of the Public Utility Holding Company Act of 1935, Electric Bond and Share was divested of control of its utilities in the Pacific Northwest.[11]

Federal development in the production of electricity in the Northwest began at the turn of the century. As a result of the Reclamation Act of 1906, the first Federal hydroelectric plant began generating electricity from the Minidoka Reclamation Project of 1909.[12] Large scale participation began in 1933 when funds were first allocated by Congress for the Bonneville Dam Project. Federal involvement was necessary because the nation's hydro resources, and particularly those of the Pacific Northwest, were of such magnitude that their maximum utilization was beyond the financial capacity of any existing private or public organization. It was also felt that such projects would not only provide employment but would also be a catalyst to

help stimulate investment from a locally depressed private sector.[13] At the same time, private utility development was inhibited through Federal legislation regulating the production and distribution of electricity.[14]

Today, the Federal government is involved in power development through three administrative units. The Army Corps of Engineers and the Bureau of Reclamation are the construction agencies for all hydro dams in the West Group Area. After construction is completed these agencies maintain and operate such projects for irrigation, recreation, navigation, flood control, etc. In the generation of hydroelectricity, both agencies are responsible for the operation and maintenance of the power generators. After power is produced and transmitted to nearby switchyards, the third Federal agency gains jurisdiction.

The Bonneville Power Administration (BPA) is responsible for the marketing and distribution of Federally produced power. Under the Bonneville Act of 1937 BPA is:

> Authorized and directed to provide, construct, operate, maintain and improve such transmission lines and substations, and facilities and structures appurtenant thereto, as he (the Administrator) finds necessary, desirable, or appropriate for the purpose of transmitting electric energy...to existing and potential markets (and) to interconnect the Bonneville Project with other Federal projects and publicly owned power systems now or hereafter constructed.[15]

From this provision, the basis was laid for much of BPA's current administrative policy.[16]

The Act equips the Administrator with powers needed in the performance of his main duties.

1) He is to encourage the widest possible use of all electric energy that can be generated and marketed, to provide outlets for it, and to prevent its monopolization.
2) Municipal and cooperative utilities will be given preference in the sale of electric energy.
3) In a conflict between the application of a public body and that of a private agency for the allocation of power, the former shall have preference.
4) Contracts for the wholesaling of electric energy shall not exceed 20 years and a contract with a private firm must provide for cancellation upon five years notice.
5) Contracts with private utilities must contain stipulations concerning resale rates which will ensure resale to the consumer at a reasonable rate.
6) The Administrator will set rates, subject to the approval of the Federal Power Commission (FPC), with a view to encourage the widest possible use of electric energy. This injunction is only limited by the stipulation that rates must be high enough so that the costs of producing and transmitting electricity, including the amortization of the

capital investment, can be recovered over a reasonable period of years.

Beginning in the mid-fifties, a new dimension in BPA responsibilities evolved, the wheeling policy. When the Eisenhower Administration adopted a "no new starts policy" on Federal dam construction, Chelan and Grant County, Washington, P. U. D.'s were faced with a potential power shortage by 1959.[17] To avert this possibility both utilities erected Priest Rapids and Rocky Reach Dams on the mid-Columbia River. However, a number of smaller utilities, whose purchase of shares in the output from these dams was essential to the financing of them, did not have the means to build transmission lines from the dams to their load centers.[18] Since such revenues were essential to the dams' success BPA agreed to transport (that is, wheel) firm energy produced at these projects over the Federal transmission system to the load centers of participating utilities.[19]

Wheeling was further advanced in 1959 with construction of Wanapum Dam by Grant County P. U. D. Up until this time BPA refused to wheel secondary energy if the Federal system had its own to sell. Even if it displaced their own sales, BPA agreed that purchasers of wheeling capacity could use this capacity to wheel their own power or anyone else's up to the limit of the capacity they had purchased.[20]

As it now stands, current wheeling policy holds benefits for all participants. It provides BPA with a better loading of facilities,

thereby making possible more efficient use of equipment at lower average costs. A wheeling policy holds to a minimum the amounts of land cleared and used for transmission rights-of-way, and all participants can take advantage of the economies offered by transmission over the Federal network of high voltage power lines. Finally, BPA's wheeling program is an important revenue producer. By fiscal year 1971 it produced $9,507,000 or over six percent of BPA's total revenues.[21] Though the scope of power operations in the West Group Area is a composite of Federal and non-Federal entities, the Federal Government is the dominant producer and transmitter of electric energy (Table 1).

In 1971-1972 West Group Area utilities generated an average of 12,284 megawatts (mw) of power. Of this total, 26 Federal dams and small thermal sources supplied over 60 percent of the power with public and private utilities generating the rest, at 11.7 and 27.5 percent respectively. Table 2 reveals that 84.2 percent of this generation came from hydro sources and only 11.7 percent from thermal.* With regards to individual utility participation in hydro and thermal generation, the Federal Government dominated non-Federal utilities by nearly

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* A figure commonly given for the amount of hydro generation produced in the region is 94 percent. This represents a peak generation situation. When talking about yearly generation an average generation figure is used. As is demonstrated in Table 2 the average hydro generation figure for 1971-1972 is 84.2 percent.

TABLE 1

West Group Area Resources of the Pacific
Northwest Power Pool
Average Generation
(Megawatts)

	1971-1972		1991-1992	
	Avg.	%	Avg.	%
Critical Period Months	$8\frac{1}{2}$		$42\frac{1}{2}$	
Federal	7467	60.8	14513	43.5
Public	1435	11.7	2194	6.6
Private	3382	27.5	16680	49.9
Total	12284	100.0	33387	100.0

Source: U.S., Department of Interior, Bonneville Power Administration, The Hydro-Thermal Power Program: A Status Report, (Portland Oregon: Bonneville Power Administration, 1971), Appendices 1 and 2.

TABLE 2

Breakdown of West Group Area Average Resources
by Means of Generation and Utility Participation
(Megawatts)

1971-1972	Means of Generation		Utility Participation			
Critical Period-Months	$8\frac{1}{2}$		Fed.	Pub.	Pri.	Total
Hydro	10342	84.2%	60.2%	12.4	27.4	100.0
Thermal	1435	11.7	72.9	10.6	16.5	100.0
Import	507	4.1	37.7	0	62.3	100.0
Total	12284	100.0				
1991-1992						
Critical Period-Months	$42\frac{1}{2}$					
Hydro	13391	40.1%	66.0%	13.7	20.3	100.0
Thermal	19520	58.5	27.3	1.8	70.9	100.0
Import	476	1.4	74.4	0	25.6	100.0
Total	33387	100.0				

Source: U. S., Department of Interior, Bonneville Power Administration, The Hydro-Thermal Power Program: A Status Report, (Portland, Oregon: Bonneville Power Administration. 1971), Appendices 1 & 2.

the identical percentages shown in Table 1 for 1971-1972. Aside from power generation the Federal Government maintains an extensive high-voltage transmission system.

As of June 1971, BPA had 11,481 circuit miles of high-voltage lines and over 300 substations (Illustration 3).[22] Of its existing lines, about 66 percent of them are 230 mw or higher. In operating the largest high voltage line system in the West Group, BPA wheeled over 8.2 million kilowatts of non-Federal power. Its grid has the capacity to transmit about 80 percent of the region's total power load.[23]

POWER DEFICITS

Beginning in 1971 and continuing intermittently thereafter, the West Group Area may experience a deficit of resources to meet total load requirements. Though the annual future load growth rate is expected to shortly stabilize from 8 percent to 5.5 percent between 1971 and 1981, a power shortage is predicted for the area in all but three years (Table 3). The power supply situation for the next ten years is expected to be so critical that unanticipated load growth or extreme weather conditions may cause even greater deficits. Beyond 1981 Table 3 demonstrates that power deficits are expected to continue though they may not be as severe as the ones anticipated for this decade. The reasons for this deficit are linked to past and current developments.

One factor is the delay of Federal funds for additional hydro

MAJOR FEDERAL AND NON-FEDERAL TRANSMISSION LINES

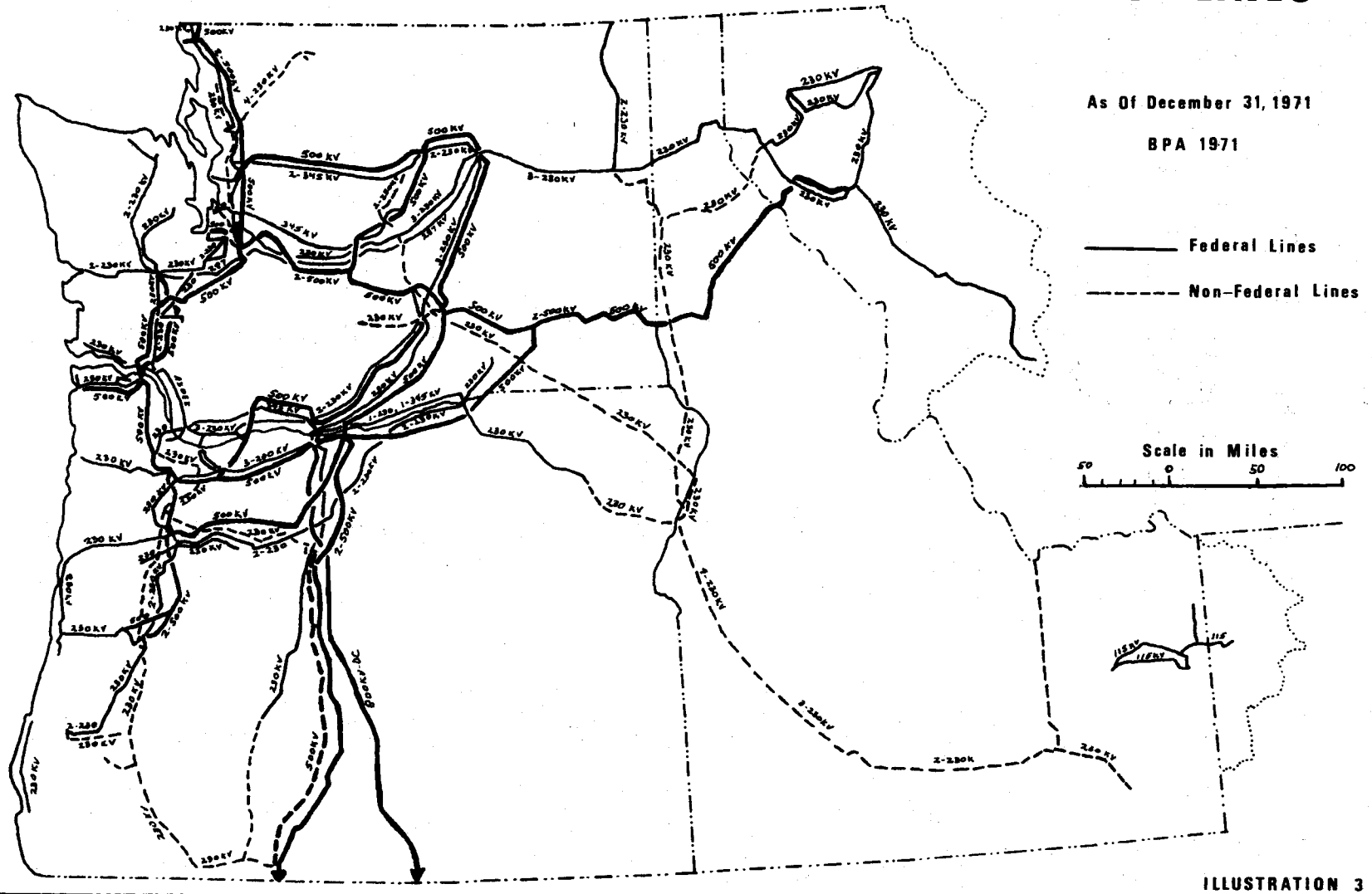


ILLUSTRATION 3

generation and related transmission facilities. In the mid-sixties, 20 year contracts for large blocks of Federal power were being drawn up and signed on the premise that 3000 mw of power would be available from projects then being authorized by Congress.[24] The only remaining item to be enacted was the actual appropriation of funds by Congress to the Corps of Engineers and the Bureau of Reclamation to build those hydro facilities. A problem was created when this money was not immediately forthcoming.

As late as October 1967, President Johnson entered into a dispute with Congress over delayed appropriations to the Defense Department. President Johnson ordered the Defense Department to defer funds on all non-essential military construction projects because Congress had not passed the military appropriations bill.[25] This action was taken because the Pentagon did not want to let contracts out for lower priority projects. They were afraid that there would not be enough money to complete projects related to the Vietnam War and the development of new weapons.[26] In addition, it appears that Johnson wanted to put pressure on Congress to pass the appropriations bill by getting congressional constituents angry through the withholding of Federal funds for local public works projects. This freeze by the Defense Department delayed for a time $8.6 million worth of projects in the Pacific Northwest.

The situation was further aggravated in the beginning of 1968 when the Department of Interior announced a $20 million cutback in

TABLE 3

West Group Area Loads and Resources 1971-1992
Average Resources
(Megawatts)

	1971-72	1972-73	1973-74	1974-75	1975-76	1976-77	1977-78
Critical Period-Months	8½	20½	42½	42½	42½	42½	42½
Loads:							
Area Firm Load	11231	12018	12644	13244	14016	14689	15542
Exports	1055	1247	1317	1160	745	729	710
Reserves for Load Growth	0	0	0	318	335	359	371
Interruptible Load	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Total Load	12286	13265	13961	14722	15096	15777	16623
Resources:							
Hydro	10342	10758	11407	11549	11854	11885	11902
Imports	507	486	703	448	533	535	545
Thermal	+ 1435	+ 1742	+ 1943	+ 2211	+ 2735	+ 3083	+ 3760
Gross Resources	12284	12986	14053	14208	15122	15503	16207
Forced Outage Reserves & Hydro Maintenance	- 26	- 53	- 58	- 59	- 58	- 59	- 57
Net Firm Resources	12258	12933	13995	14149	15064	15444	16150
Reserves Provided by Interruptible Loads	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Total Resource	12258	12933	13995	14149	15064	15444	16150
Surplus (Deficit)	(28)	(332)	34	(573)	(32)	(333)	(473)

TABLE 3
continued

	1978-79	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
Critical Period-Months	42½	42½	42½	42½	42½	42½	42½
Loads:							
Area Firm Load	16363	17218	18152	19038	20151	21252	22407
Exports	650	649	647	483	289	223	208
Reserves for Load Growth	403	411	433	464	491.	520	552
Interruptible Load	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Total Load	17416	18278	19232	19985	20931	21995	23167
Resources:							
Hydro	11933	11967	12044	12107	12164	12334	12496
Imports	572	572	572	572	565	533	501
Thermal	+ 4845	+ 5834	+ 6755	+ 7228	+ 8362	+ 8972	+ 9976
Gross Resources	17350	18373	19371	19907	21091	21839	22973
Forced Outage Reserves & Hydro Maintenance	- 58	- 57	- 58	- 57	- 58	- 57	- 58
Net Firm Resources	17292	18316	19313	19850	21033	21782	22915
Reserves Provided by Interruptible Loads	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Total Resource	17292	18316	19313	19850	21033	21782	22915
Surplus (Deficit)	(124)	38	81	(135)	102	(213)	(252)

TABLE 3
continued

	1985-86	1986-87	1987-88	1988-89	1989-90	1990-91	1991-92
Critical Period-Months	42½	42½	42½	42½	42½	42½	42½
Loads:							
Area Firm Load	23632	24825	26118	27478	28896	30491	32100
Exports	195	136	120	120	127	123	123
Reserves for Load Growth	584	616	654	696	734	772	810
Interruptible Load	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Total Load	24411	25577	26892	28294	29757	31386	33033
Resources:							
Hydro	12811	13219	13326	13341	13408	13391	13391
Imports	476	476	476	476	476	476	476
Thermal	+10938	+11939	+13152	+14486	+15913	+17693	+19520
Gross Resources	24225	25634	26954	28303	29797	31560	33387
Forced Outage Reserves & Hydro Maintenance	- 57	- 58	- 57	- 58	- 57	- 58	- 57
Net Firm Resources	24168	25576	26897	28245	29740	31502	33330
Reserves Provided by Interruptible Loads	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Total Resource	24168	25576	26897	28245	29740	31502	33330
Surplus (Deficit)	(243)	(1)	5	(49)	(17)	116	297

Source: U. S., Department of Interior, Bonneville Power Administration, The Hydro-Thermal Power Program: A Status Report (Portland, Oregon: Bonneville Power Administration, 1971), Appendix 1.

its controllable obligations during the remainder of the fiscal year.[27] These cutbacks affected both the Bureau of Reclamation and the BPA. In that same year, Congress authorized a public works bill $408 million less than what President Johnson requested and $190 million less than the budget for fiscal year 1969.[28]

Through the change in administrations in 1969, budgetary restrictions continued as President Nixon ordered a 75 percent reduction in new contracts for government construction.[29] The financial cutbacks in the late sixties lead to delays in generator installation schedules at Federal hydro projects at The Dalles, Libby, Grand Coulee Third Power Plant, Dworshak and Lower Granite. The needed megawatts of power were delayed, contributing to a power deficit.[30] Another reason for projected power deficits concerns the increased stress on environmental protection.

It is expected that large amounts of electric power will be used in improving the environment. Though it is impossible to measure the exact amounts of power needed, specific energy uses include: industrial air and water pollution control; electric heat; conversion from fossil fuel uses to electric energy; electrified transportation; improved street, highway and security lighting; municipal sewage treatment; solid waste disposal; and recycling.

Environmental protection measures utilized by generating plants themselves are a large consumer of electricity. The use of cooling towers instead of once through cooling for thermal generating plants

causes a loss in efficiency of five to six percent. This means that five to six percent more fuel must be burned to provide the same amount of electrical energy.[31] In addition, the location of thermal plants far from population and load centers adds to transmission losses, requiring plants to generate more electricity to compensate for expected losses. These two environmental considerations consume ten percent or more of the energy generated.[32]

Environmental protection measures will also need electricity in the area of industrial air and water pollution control. A 1970 survey of BPA's 22 direct service industrial customers indicated that they were using over 500 million kwh per year for environmental protection. In one instance, a BPA served pulp mill requested 7.5 megawatts of power for pollution control. If each of the 45 mills in the region utilizes that much electricity for pollution control, electric energy consumption could become significant.

Electric heating, improved lighting systems and electrified mass transit may very well prove to be other environmentally associated loads. For example, in 1970 residential heating in the West Group Area consumed nearly a billion kilowatt hours or nearly 33 percent of the total electrical energy consumed by residential customers.[33] In the next twenty years this consumption is expected to increase by over three times.[34] Another contributor to the predicted power deficit appears to be the population's consumption of electricity.

Growth in the residential consumption of electric energy is due

largely to increased per capita use. Between 1950 and 1970 electric energy use per residential consumer almost tripled from 5,112 to 13,831 kwh.[35] This resulted in total domestic loads sky-rocketing from 5.5 billion to 27.4 billion kwh.[36] Illustration 4 demonstrates that in 1970 population growth accounted for less than one-fifth of increased residential use. The remaining 80 plus percent was accounted for by increased per capita consumption. By 1980, residential consumption is expected to require an increasing amount of energy sales. In response to the forecasted power deficits power concerns in the West Group Area have devised a plan to alleviate the problem.

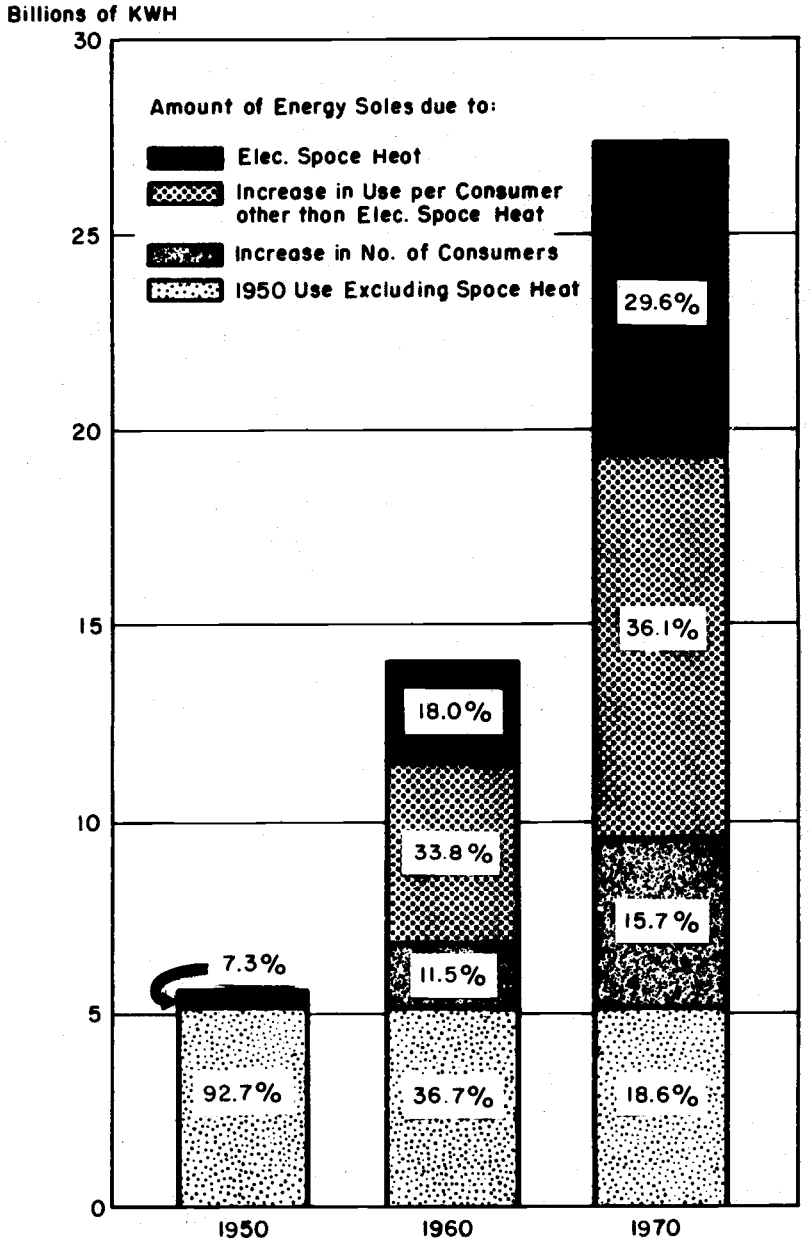
THE HYDRO-THERMAL POWER PROGRAM

With Federal, public and private utilities expecting total power requirements for the West Group Area to nearly triple by 1992, hydro production must be supplemented with an alternative source of generation. Though 84 percent of the region's average power is now generated from hydro projects, as early as 1981-1982 much of the additional power will be generated from non-hydro sources.

> From 1971-72 through 1981-82, about 15,100 megawatts of peaking capacity and 7600 average meagawatts of energy capability will have to be added in the region. Hydroelectric generation will account for 52 percent of the additional peaking capability but only 23 percent of the additional energy

ILLUSTRATION 4

FACTORS CAUSING INCREASE IN ENERGY SALES TO RESIDENTIAL CONSUMERS IN WEST GROUP OF PNW 1950 - 1970



Source: U.S. Department of Interior, Bonneville Power Admistration, The Hydro-Thermal Power Program: A Status Report, p. 4.

capability.[37]

Between 1981 and 1992 an additional peaking capacity of nearly 25,600 mw will be required with another 13,500 mw needed for further energy capability.[38] Of these amounts it is expected that hydro will supply about one-third of the peaking power and only 9 percent of the additional energy capability.[39] To meet this situation effectively a power generation program was conceived by the 109 members of the West Group Area.

The Hydro-Thermal Power Program will meet increased power needs in the West Group Area by: increasing peaking generation, providing additional base load requirements, and increasing the capacity of transmission systems to carry greater power loads from generation sources to load centers. To meet these objectives, the region's utilities and the Federal Government are planning, building and operating the region's electric system on a coordinated basis. Under the plan:

1) Non-Federal utilities will build large capacity thermal plants located, sized and scheduled to best satisfy regional needs. In terms of meeting regional loads up through 1982, the eight thermal plants shown in Table 4 will be needed.
2) Maximum sized thermal plants will provide limited amounts of surplus power to be acquired by BPA on a short term withdrawable basis from private utilities under exchange agreements.

TABLE 4

Installation Schedule for Thermal Projects Through 1981

Plant Name	Type of Fuel	Rating Unit	Rating mw	Date Scheduled	Sponsor	Location
Centralia	Coal	1	700	1971	PP&L Co.	Centralia, WA
		2	700	1972	& WWP Co.	
Trojan	Nuclear	1	1,130	1974	PGE Co.	Rainier, OR
Jim Bridger	Coal	2	500	1975	PP&L Co.	Rock Springs, WY
		3	500	1976	PP&L Co.	
Hanford No. 2	Nuclear	1	1,100	1977	WPPSS	Richland, WA
Colstrip	Coal	4	1,400*	1975-1979	PSP&L Co.	Colstrip, MT
WPPSS (NSSS)**	Nuclear	1	1,126	1980	WPPSS	Richland, WA
Boardman	Nuclear	1	1,100	1980	PGE	Boardman, OR
WPPSS No. 3	Nuclear	1	1,100	1981	WPPSS	Unknown

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* Portion of 2100 mw rating to be available under Hydro-Thermal Power Program

** Washington Public Power Supply System (Nuclear Steam Supply System)

Source: Richard Beck, (ed.), Oregon Nuclear and Thermal Energy Council, "A Dialogue on Power Demands: A Discussion of Power Utilization in the Pacific Northwest," Salem, Oregon, 1973, p. III-3. (Mimeographed)

3) A net billing procedure will be implemented so that BPA can acquire a public agency's share of thermal plant capability.

4) All acquired thermal power will be pooled with hydro-generated power and furnished to area customers at established rates.

5) Peaking power, forced outage reserves, reserves for unanticipated load growth and surplus hydro-energy for thermal displacement will be provided, when available, to private utilities by the Federal power system. To fulfill these requirements through 1981 additional hydro generating capacity must be added to the existing hydro system (Table 5).

The thermal and hydro generation provided by the facilities in Tables 4 and 5 will provide the needed peaking capacity and energy capability for the West Group Area up through 1981. Additional facilities will be needed to meet future demands beyond 1981. Besides providing additional hydro facilities, the Federal Government will construct the necessary transmission facilities to transmit the increased electrical load.

To serve growing Northwest loads, and to handle the large amounts of energy to be produced by the large thermal and hydro plants, regional extra-high voltage transmission lines are being built by the BPA.[40] At the present time BPA is building a 500-kv grid to overlay its present system. Each new 500-kv line is capable of carrying twice the output of Bonneville Dam and it has nearly five times the capacity of

TABLE 5

Installation Schedule for Hydro Projects
Through 1981

Project	Number of Units	Total Nameplate Rating (mw)	Initial Date of Operation	Status
Rocky Reach Additions (Chelan Co. PUD)	4	501.6	8/71-11/71	UC
John Day*	2	270	8/71-10/71	UC
The Dalles*	8	688	8/72-5/74	UC
Dworshak*	3	400	11/72-5/73	UC
Grand Coulee Pump Generators*	2	100	4/73-6/73	UC
3rd Powerplant*	6	3600	2/74-9/80	UC
Ice Harbor*	3	333	2/75-8/75	UC
Lower Granite*	3	405	4/75	UC
Libby*	4	420	7/75-4/76	UC
Lost Creek*	2	49	4/76-6/76	UC
Teton*	2	20	5/76-6/76	UC
	1	10	6/78	F
Chief Joseph*	11	1045	11/76-11/78	P
Bonneville 2nd Powerplant*	6	324	2/78-5/79	P
Little Goose*	3	405	2/78-8/78	P
Asotin*	2	270	4/80	P
Guffey	4	85	7/81	F

UC - Under construction
P - Planned for early construction
F - Future potential
* - Authorized for Federal construction

Source: U. S., Department of Interior, Bonneville Power Administration, The Hydro-Thermal Power Program: A Status Report (Portland, Oregon: Bonneville Power Administration, 1972), Appendix 3.

a standard 230-kv line.[41] The higher voltage lines provide more capacity at less cost per kilowatt and they require much less right-of-way. For example, a 230-kv line utilizes a right-of-way 125 feet wide while a 500-kv line can be built on a strip of land only ten feet wider. In addition, facilities at existing substations will be replaced by higher capacity equipment. By encouraging regional power generation and transmission it is believed that fewer facilities will be needed to supply growing electrical demands.

The monetary investment in power facilities under the Hydro-Thermal Power Program is expected to reach a total of $21 billion by 1991.[42] The following is a breakdown of future costs, based on BPA calculations.

TABLE 6

A Breakdown of Costs for the Hydro-Thermal Power Program

		Billions of Dollars	
Thermal Plants	Federal	0.0	
	Non-Federal	5.37	
	Total		$ 5.37
Hydro Plants	Federal	2.10	
	Non-Federal	.61	
	Total		2.71
High Voltage Transmission Facilities	Federal	2.34	
	Non-Federal	.50	
	Total		2.84
Low Voltage Transmission Facilities	Federal	0.0	
	Non-Federal	6.90	
	Total		6.90
----------	TOTAL		$17.82

Table 6, continued:

Source: Public Power Council, "Editorial Background Information II Joint Power Planning Council Guides Power Development," Vancouver, Washington, 1971, p. 7. (Mimeographed)

Non-Federal utilities are financing 74.5 percent of the new program. Implementation of the Federal portion of the program was initiated by Congress in the Public Works Appropriations Act of 1970. This Act insures full Federal participation in the project up through 1981.[43] Though it is not known whether President Nixon has held up such appropriations through the Office of Management and Budget, his Administration did approve the Hydro-Thermal Power Program in 1970.[44] A unique aspect of the Hydro-Thermal Program is the marketing procedure to be followed.

Though Federally produced power will still be marketed according to the preference clause of the 1937 Bonneville Power Act, the distribution of power from the new thermal units will be a cooperative effort between all members of the West Group Area. Under a procedure known as net billing, public utilities will be able to own a portion of these large thermal plants. For their investment each participating agency will receive a portion of the project's power capability. The BPA will then purchase the public agency portion of the output of these large thermal projects. As payment for this power, BPA will offset a participating public agency's annual cost

in the project against BPA's billing to the participant under the participant's contracts with BPA. Net billing procedures of this nature result from contractual arrangements between BPA and public utilities. It is expected that the Federal Government will not purchase power from the private utility portions of future thermal plants through net billing procedures.

One example of net billing is PGE's Trojan nuclear plant at Rainier, Oregon. Under current arrangements, the Portland General Electric Company will construct and operate the plant, and it will finance 67.5 percent of its cost. Other owners will be Pacific Power and Light Company (2.5 percent) and Eugene Water and Electric Board (30 percent). In turn, EWEB will assign 14.5 percentage points of its 30 percent ownership share of project output to BPA and assign the remaining 15.5 percentage points to the 13 public agencies listed below.

TABLE 7

Municipal Participation in the Trojan Project

	Participants Share %
Blachly-Lane Cooperative Electric Assoc.	0.006
City of Canby	0.005
Clatskanie Peoples' Utility District	0.054
Consumers Power, Inc.	0.011
City of Forest Grove	0.009
Lincoln Electric Cooperative (WA)	0.006
City of McMinnville	0.010
City of Monmouth	0.005
Northern Wasco Peoples' Utility District	0.003
Salem Electric	0.016
City of Springfield	0.018

Table 7, continued:

Umatilla Electric Cooperative Assoc.	0.010
Western Oregon Electric Cooperative	0.002
	0.155
Total	15.5%

Source: Richard Beck, (ed.), Oregon Nuclear and Thermal Energy Council, "A Dialogue on Power Demands: A Discussion of Power Utilization in the Pacific Northwest," Salem, Oregon, 1972, p. IV-10. (Mimeographed)

Each participant assigns its respective shares to BPA and it will pay EWEB its pro rata share of the annual costs of the project. Then, BPA will pay for the project power output assigned to the 14 public power participants in the following manner. Usual monthly billings by BPA to the 14 public power participants in Trojan will be reduced by credit or offset for the amount each participant has paid as its share of the annual costs to Trojan.

It should be noted that Trojan is not the first power project in the West Group Area to come under net billing arrangements. PP&L, WPPSS, Puget Sound Power and Light Company, PGE, Snohomish PUD, Grays Harbor PUD, City of Seattle and City of Tacoma are participating under similar net billing arrangements with BPA for the Centralia Thermal Project at Centralia, Washington.[45]

The advantages of net billing go to all participants in the Hydro-Thermal Power Program. The major sponsoring utility not only gets

its own expenses cut in the construction and operation of a large thermal plant, but it is also able to unload capacity that it would be unable to market in its own service area. As these net billing contracts come up for renewal the sponsoring utility can claim more of the plant's output. Public utilities benefit because the power that they eventually purchase from BPA will be at BPA rates. Since nuclear power will cost at least six times more to produce than Federally generated hydro power, public utilities get to purchase more power per dollar on their original investment.[46*] And, in the case of Trojan, these utilities have an option to directly purchase thermal power if future circumstances require it. Finally, BPA benefits by having made available more power to it to satisfy its load demands. Thus, net billing provides a unique facet to the Hydro-Thermal Power Program.

CONCLUSIONS

Implementation of the Hydro-Thermal Power Program will result in thermal generation satisfying a great deal more of the region's total power load than it has in the past. By comparing the breakdown in average resource generation for 1971-1972 and 1991-1992 (Table 2)

* A six-fold increase in the production costs of nuclear power does not mean that electrical rates will go up by the same amount. Rates will rise but in increments.

the trend towards thermal generation is apparent. According to current estimates by 1991-1992, 40.1 percent of the West Group Area's power will be generated from hydro sources. This represents a drop of 44.1 percent in the amount of electricity supplied by hydro generation. Conversely, thermal generation will increase by nearly the same amount, 46.8 percent, bringing thermal participation up to 58.5 percent.

In terms of total average generation the amount of participation between Federal and non-Federal utilities is expected to change dramatically in the next twenty years. As Table 1 clearly demonstrates between 1971 and 1992, Federal participation is expected to decrease from 60.8 percent to 43.5 percent while non-Federal participation should jump from 39.2 percent to 56.5 percent. During this same period of time Federal and non-Federal utilities will dominate the hydro and the thermal sectors of generation, respectively (Table 2).

As of 1971 the Federal Government was the major participant in all methods of power generation in the West Group Area. At that time Uncle Sam generated over 60 percent of the hydro and over 72 percent of the thermal power produced in the region. By 1992 the Federal Government is expected to produce 66 percent of the hydro power generated in the West Group Area. Nearly the opposite pattern will develop for non-hydro generation. Seventy-two percent of the average thermal generation is expected to be produced from non-Federal

sources. However, more than providing a new means of producing power, the Hydro-Thermal Power Program is a continuation of an extensive power network in which a high degree of cooperation has been fostered in the past.

Though the pooling of power resources first began in 1917, the Pacific Northwest Power Pool was first established in 1941. Consisting of eighteen utility systems the pool operates as if it were one system under single management. To reach this end the members of the pool have established an operational policy to which all participants closely adhere. While operating for the overall good of the pool, each member has immediate and full control of its own operations.

Up until 1965, the Pacific Northwest Power Pool operated on a voluntary basis without the use of contractual agreements to coordinate the operations of the member utilities.[47] But, the signing of the Canadian-U. S. treaty for the development of the Columbia River in Canada and the establishment of the Pacific Northwest-Southwest Intertie required West Group Area members to formalize and expand power pool activities under a long term coordination contract.[48] As of January 4, 1965, day-to-day operations of the member utilities were to continue on an individual basis; however, overall operational procedures which could affect stream flow and total power system's efficiency and reliability were drawn up as the Pacific Northwest Coordination Agreement.[49] In addition to these

structured operating agreements there are also informal organizations which play an important role in the planning of the region's electrical needs.

The Pacific Northwest Utilities Conference Committee (PNUCC) is an informal organization composed of representatives from publicly-owned, cooperatively-owned and investor-owned electric utilities in the West Group Area. Activities of PNUCC include the reviewing of Federal plans and programs related to the area's electrical system, the lobbying for area Federal power projects and transmission facilities, and the preparation and evaluation of loads and resources on an annual, regional basis.

The annual power loads and resources report is known as the "West Group Forecast." The study collects and compiles load forecasts of all utilities in the West Group. These forecasts, projected ten years in advance, compare each year of forecasted loads with existing and scheduled generating resources. Though PNUCC has no official regional function, its power surveys serve as the basis for the West Group Area's power forecasts. While PNUCC serves in a regional lobbying and forecasting capacity, the Joint Power Planning Council (JPPC) serves in a regional planning function.

JPPC is an informal organization of nearly all of the public, private and Federal utilities of the West Group Area. Created in November 1966, the Council meets periodically throughout the year to coordinate the operation and planning of the regional power system.

In addition, the Council serves as a platform where members can inform each other on matters relating to the region's power situation. The Council's most important contribution to date is the Hydro-Thermal Power Program.

In effect, the Hydro-Thermal Power Program is a contribution of Federal- non-Federal cooperation dating back to the early days of World War II. Though this involvement has been fostered for over three decades by unofficial understandings and more recently by contractual agreements, the Hydro-Thermal Power Program represents a commitment in terms of real capital investment in the construction of new generating and transmission facilities. Due to the interconnected nature of the region's power network, Federal and non-Federal systems are dependent on one another to fulfill total energy requirements. The closeness of this bond can be seen in the involvement all utilities have in the operation and planning of the West Group Area's power network. Despite this high degree of cooperation now being demonstrated between Federal and non-Federal utilities, the Hydro-Thermal Power Program does have weaknesses.

A major problem of the Hydro-Thermal Power Program is the dependence placed on all utilities getting needed facilities constructed and operating on schedule. Since the area's energy supply depends on the pooled resources of all participants, any delays in the on-line time schedule may result in higher costs, higher rates and a possible loss in systems' reliability. For example, PGE officials

calculated that a seven month delay in the completion of the Trojan nuclear power plant would cost the company an extra $38 million.[50] Of this amount, $31 million would go for increased power costs between 1974 and 1976, and $7 million would go for additional revenue requirements to cover increased capital investments.[51] Many of these added costs are related to the operation of gas turbines to cover the deficiency otherwise provided for by Trojan. There would also be an on-going revenue requirement of an additional $7.2 million to cover added costs of Trojan and numerous capital investments needed to meet regional commitments.[52]

> When new power generating capacity can be delayed by such factors as: manufacturing quality control; low productivity at plant sites; insufficient advance public disclosure; changing regulatory standards; inadequate research and development; litigation and licensing delays; and required environmental studies, putting power plants on-line on-schedule is, to say the least, difficult.[53]

Aside from delay, a regional power system of this nature is subject to a second drawback.

A key feature of the Hydro-Thermal Power Program is the centralization of resources. In essence, an area is served by large generating facilities which are interconnected through high-voltage power lines. Since all members of the West Group Area are totally or partially dependent on centralized transmission and generation

facilities for electrical energy, unforeseen delays in the construction of new facilities or the malfunctioning of existing ones can upset the entire energy network. For example, troubles encountered with stack emission control devices delayed the first 700 mw unit at Centralia from going on-line at the originally scheduled date of September 1, 1971.[54] Without the full output from this unit, secondary energy deliveries were curtailed for a month so the BPA's firm energy obligations could be met through the remainder of the year.[55] Those customers depending on that secondary energy, mainly industry and private utilities, were forced either to find alternative sources of power or to go without. Assurances of such a situation not occurring again are impossible to make. A third problem of the program is the major role the Federal Government plays in the construction of necessary power facilities.

All Federal facilities associated with the Hydro-Thermal Power Program are dependent on funds allocated by Congress. To date funds appropriated by Congress will complete projects necessary to meet the power needs of the West Group Area through 1980. Beyond this time it is uncertain whether funding will be provided to continue Federal participation in the program. In addition, the President can withhold funding through the Office of Management and Budget. Obviously, bureaucractic delays in Washington can jeopardize the region's utilities from meeting load levels. It will be recalled, for example, that delayed funding for the completion of specific Federal

hydro generating facilities was one contributing factor to the region's predicted power deficits.

In conclusion, under the Hydro-Thermal Power Program the thermal generation of electricity will be playing an important role in meeting the future electrical energy needs of the West Group Area of the Pacific Northwest. However, there are problems which may cut down its efficiency.

FOOTNOTES

1 U. S., Department of Interior, Bonneville Power Administration, About BPA (Portland, Oregon: Bonneville Power Administration, 1971), p. 5.

2 Ibid.

3 U. S., Congress, House, Committee on Government Operations, Effect of Administrative Acts and Policies of Department of Interior and Rural Electrification Administration on Rural Electric Cooperatives, Public Bodies and Municipal Electrics, Hearings, before a subcommittee of the Committee on Government Operations, House of Representatives, 84th Cong., 1st sess., 1955, p. 793.

4 Pacific Northwest River Basins Commission, Columbia-North Pacific Region Comprehensive Framework Study, Appendix XV Electric Power (Vancouver, Washington: Pacific Northwest River Basins Commission, 1970), p. 2.

5 Ibid.

6 Emery Troxel, Economics of Public Utilities, (New York: Rinehart and Company, Inc., 1947), p. 488-490.

7 Pacific Northwest River Basins Commission, op. cit., p. 2.

8 Ibid. p. 3.

9 Twentieth Century Fund, The Power Industry and the Public Interest (New York: Twentieth Century Fund, 1944), p. 12-13.

10 Pacific Northwest River Basins Commission, op. cit., p. 3.

11 Ibid.

12 Ibid., p. 4.

13 Troxel, op. cit., p. 687.

14 Charles McKinley, Uncle Sam in the Pacific Northwest; Federal Management of Natural Resources in the Columbia River Valley (Los Angeles: University of California Press, 1952), p. 227.

15 Ibid., p. 161.

16 Ibid.

17 U. S., Department of Interior, Bonneville Power Administration, 1965 Report, U. S. Columbia River Power System (Portland, Oregon: Bonneville Power Administration, 1965), p. 9.

18 Ibid.

19 Ibid.

20 Ibid.

21 U. S., Department of Interior, Bonneville Power Administration, Federal Columbia River Power System 1970 Annual Report, (Portland, Oregon: Bonneville Power Administration, 1970), p. 51.

22 U. S., Department of Interior, Bonneville Power Administration, About BPA, p. 5.

23 Ibid.

24 Richard Beck, (ed.), The Oregon Nuclear and Thermal Energy Council, "A Dialogue on Power Demands: A Discussion of Power Utilization in the Pacific Northwest," Salem, Oregon, 1972, p. IV-32. (Mimeographed)

25 New York Times, October 6, 1967, 1:8.

26 Ibid.

27 New York Times, January 24, 1968, 55:2.

28 New York Times, June 15, 1968, 1:4.

29 New York Times, September 5, 1969, 23:1.

30 U. S., Department of Interior, Bonneville Power Administration, Federal Columbia River Power System 1970 Annual Report., p. 6.

31 Beck, op. cit., p. II-21.

32 Ibid.

33 Ibid., p. II-22.

34 Ibid.

35 U. S., Department of Interior, Bonneville Power Administration, The Hydro-Thermal Power Program: A Status Report (Portland, Oregon: Bonneville Power Administration, 1972), p. 3.

36 Ibid.

37 U. S., Department of Interior, Bonneville Power Administration, The Hydro-Thermal Power Porgram: A Status Report, p. VI.

38 Ibid., p. 14.

39 Ibid.

40 Ibid., p. 15.

41 U. S., Department of Interior, Bonneville Power Administration, About BPA, p. 7.

42 Public Power Council, "Editorial Background Information II Joint Power Planning Council Guides Power Development," Vancouver, Washington, 1971, p. 6. (Mimeographed)

43 U. S., Department of Interior, Bonneville Power Administration, Federal Columbia River Power System 1970 Annual Report, p. 2.

44 Ibid.

45 Beck, op. cit., p. IV-6.

46 Ibid., p. IV-39.

47 "Northwest Power Pool," p. 6. (Mimeographed)

48 Ibid.

49 Ibid.

50 Beck, op. cit., p. III-12.

51 Ibid.

52 Ibid.

53 Ibid., p. 5-6.

54 U. S., Department of Interior, Bonneville Power Administration, Federal Columbia River Power System 1971 Annual Report (Portland, Oregon: Bonneville Power Administration, 1971), p. 17.

55 Ibid.

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