BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Secretary Of Energy

Oil Savings From Greater Intertie Capacity Between The Pacific Northwest And California

Over 4 million barrels of oil might be saved annually by expanding the electrical transmission line capacity between the Pacific Northwest and California.

This report makes recommendations to the Department of Energy to assure these benefits are realized.

EMD-80-100

SEPTEMBER 24, 1980

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UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

ENERGY AND MINERALS
DIVISION

B-199624

The Honorable Charles W. Duncan, Jr.
The Secretary of Energy

Dear Mr. Secretary:

As part of our continuing effort to assess the Federal power marketing agencies' operations and because the existing interties between the Pacific Northwest-Southwest cannot carry the potential for all power exchanges, we studied the benefits from expanding the Pacific Northwest-Southwest electricity interconnections. This study involved the Bonneville Power Administration (Bonneville), Western Area Power Administration (Western), the Federal Energy Regulatory Commission (FERC) and the Economic Regulatory Administration (ERA) within the Department of Energy (Department), several utilities and States in the Northwest and Southwest as well as, the British Columbia Hydro and Power Authority.

In addition to lowering electric rates in the Pacific Northwest and California, an annual average of 4 million barrels of oil could be saved by expanding the intertie system between these areas. A little over half the oil savings (2.7 million barrels) would result from the sale of surplus energy from the Northwest, while slightly less than half (1.8 million barrels) would come from the sale of additional surplus energy from Canada.

This matter is being brought to your attention because of the possibility that Federal action may be necessary to achieve the full oil-savings potential. We provided a draft copy of this report to the Department for informal review, and on August 6 met with Departmental staff, including Bonneville, ERA, and FERC officials to obtain their comments. While there was general agreement with the thrust of the report, several areas were modified to reflect specific concerns.

BACKGROUND

Three high-voltage transmission lines (interties) connect California and the Pacific Northwest.1/ These lines consist of two 500-kilovolt (kV) alternating current (a.c.) 2/ lines and one 800-kV direct current (d.c.) line, with a combined capacity of about 4,100 megawatts (MW).3/ These lines were jointly developed by public and private power interests. Bonneville and Western funded about 26 percent of these lines and several public and private utilities funded the remainder.

These lines have permitted Bonneville and Northwest utilities to sell California utilities an annual average of about 6.8 billion kilowatt-hours (kWh) of surplus power. Surplus energy sales benefit both regions--allowing the Northwest to sell a resource which may otherwise be wasted, while allowing California utilities to turn off oil-powerplants, which make up a significant percent of their electricity generation. These surplus energy sales have reduced rates in both regions and have benefited the Nation by reducing its dependence on oil by about 11 million barrels a year.

The energy that can be produced in a predominately hydroelectric system, as exists in the Northwest, varies widely from year to year, depending on how wet the year is and when the snow melts. If sufficient storage is available, the excess water in a good year can be stored for use in a poor year. The Columbia River system, however, can store only about 25 percent of the annual precipitation. As a result, the Northwest must, to a great extent, generate power from water as it is received. Firm energy is marketed based on the most critical water period of record. Energy produced above this is considered secondary energy. If no market exists for it in the Pacific Northwest, and it cannot be stored, it becomes surplus and available for export. The variability between good and poor conditions is demonstrated by looking at 2 recent years. The year 1976 was a very good water year when the Northwest sold 25 billion kWh of electricity (equivalent to about 43 million barrels of oil) to California utilities. In

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1/See appendix I for map.

2/See appendix II for glossary of technical terms used in this letter.

3/Reduced to account for the effects of loop-flows.

contrast, poor water conditions occurred in 1977 and virtually no surplus power was available. Variance in available water within a year, as well as between years, can also result in surplus energy. For example, about 4 billion kWh of surplus energy was sold to California utilities this past spring because unexpected warm temperatures in the Northwest reduced loads while also increasing stream flow. In addition, a substantial quantity of water had to be spilled in May and June this year which, had line capacity been available, could have produced about 1 million MWh of additional electricity. The water could not be stored to produce energy for later use in the region. This occurred despite (1) water conditions which were expected to be well below average and (2) a 1979 load forecast which predicted a deficit for the year of about 14 billion kWh.

PROPOSALS FOR FURTHER INTERTIE DEVELOPMENT

Three proposals have been studied to increase the transmission capacity of the intertie system. These are:

--Upgrade the capacity of the existing d.c. line.
--Build a third a.c. line.
--Build a second d.c. line.

The first proposal involves upgrading the existing 800-kV d.c. line. The line, which is 646 miles long, would not involve any more line construction, but would involve increasing its operating voltage by installing some new equipment and insulators. According to a 1979 study, the payback period was expected to be between 4 and 8 years. Most of the benefits are from increased surplus energy sales and improved efficiency. Increased surplus energy sales are estimated to be .3 billion kWh annually. The cost of this proposal would be shared between Bonneville and the California utilities. While Bonneville has actively promoted this proposal, by the completion of our study, it had not secured an agreement from the California utilities to upgrade the line. Preliminary indications are that Bonneville is close to reaching agreements with California utilities on this proposal.

The second proposal involves adding a third 500-KV a.c. line, 585 miles long, from the John Day Dam in Oregon to Tesla, just southeast of San Francisco. The primary benefit from this line is expected to be increased use of Northwest surplus energy. Our analysis shows an average annual increase of about 1.2 billion kWh of surplus energy sales to California. Additional benefits could come from reduced line losses and improved reliability.

Both Bonneville and Pacific Gas and Electric Company (PG&E), a California utility, are considering the additional a.c. line. In October 1980 Bonneville plans to start constructing a 156-mile section of 500-kV a.c. line to be completed in January 1983. This segment was justified for reasons other than as part of the intertie. However, it could also serve as the northern end of a third a.c. line. PG&E is now studying the approximately 430 miles of line into northern California to determine if that utility wants to be involved in its construction.

The last and the oldest of the three proposals is to build a second d.c. line between the Northwest and Southwest. This proposal, which would involve 1,054 miles of new line construction, was originally authorized for Federal construction in 1964. Although its major benefits were peak capacity and surplus energy sales, the line was not built because the expense could not be justified. While Bonneville and Western reexamined this proposal between 1975 and 1978, it is not now under active study because of Bonneville's concern about its ability to enter into peak capacity exchange agreements and the Arizona utility projections that indicate a lack of need until the 1990s.

In addition to increased sales of surplus Northwest energy, other benefits are attributed to increased intertie capacity. Exchanges of peaking capacity and reserve pooling between the regions could reduce capital expenditures for new generating capacity. Resource projections for the next 10 years, however, indicate that these two benefits can be handled over the existing intertie lines. However, in the long term, as loads in the Northwest and the Southwest increase, such benefits could significantly increase.

Increased line capacity would also improve overall transmission efficiencies and reliability, thereby reducing energy losses and the susceptibility to severe power disruptions. It would also provide increased opportunity for short-term energy sales.

Increased Power Sales from Canada

An additional reason for increasing the Northwest and California line capacity is to provide increased California access to Canadian power resources. An April 1980 joint Canadian and United States study shows an annual average of about 1 billion kWh (equivalent to about 1.8 million barrels of oil) of increased Canadian surplus sales to the Pacific Southwest if intertie capacity were unconstrained.

An additional development having potential for displacing oil used in the United States is a 2,000-MW coal plant being planned for Alberta, Canada. Canadian representatives are actively attempting to market this firm energy in the Northwest and California and expect to reach an agreement by April 1981. To the extent this power is marketed in California, it will provide further oil savings and justification for increasing the Northwest California intertie capacity. To take full advantage of this resource from the new coal plant will require increasing the line capacity between the Northwest and Canada. Interties now consist of two 230-kV lines and two 500-kV lines having a total capacity of about 2,000 MW.

IS ADDITIONAL INTERTIE CAPACITY WARRANTED?

Available evidence argues strongly in favor of upgrading the capacity of the existing d.c. line and building another a.c. line. This conclusion was reached as the result of an analysis we prepared that is based on the most recent surplus energy analysis prepared by Bonneville. The only benefits included in our analysis are from the sale of surplus energy. Cost information was obtained from Bonneville or utility estimates.

The following table summarizes the annual benefits and costs, including estimated oil savings potential from each of the three proposed line expansions.

	Amount of surplus (million kWh) (note a)	Potential oil savings (mil bbl) (note b)	Annual Benefits (million) (note c)	Annual costs (million) (note d)	Increment of line capacity (MW)
d.c. upgrade	385	0.6	$21.9	$10	360
3rd a.c.	1,235	2.1	70.4	49	1,500
2nd d.c.	570	1.0	32.5	75	2,200

a/ Assuming development in this sequence.

b/ Oil to kWh conversion = 600 kWh per bbl.

c/ In 1990 dollars based on a cost differential of (66 mills for oil-fired generation and 8.77 Northwest surplus energy) 57 mills per kWh.

d/ Assumption made for financing:

d.c. upgrade - Bonneville, 50 percent; California participants 50 percent-(public 25 percent; private, 25 percent).

3rd a.c. - Bonneville, 10 percent; private, 90 percent.

2nd d.c. - Bonneville, 40 percent; Western, 60 percent.

The above analysis shows that benefits exceed costs for both the d.c. upgrade and third a.c. line, but costs would exceed benefits for the second d.c. line. The upgrade proposal comes out favorably because its total costs are significantly lower due to the fact that it does not involve land purchases or new line construction costs, but relies on the addition of new equipment and increasing insulators. The third a.c. line does involve new line construction costs, however, the number of miles for it is significantly less (430 miles) than the second d.c. line (1054 miles). Bonneville officials have reviewed, and are in agreement with the assumptions and basic data used in the above analysis.

Our analysis, we believe, is conservative. For example, it is based on water conditions during a 40-year period. Bonneville officials told us that an analysis based on a 99-year period would be more accurate and would increase benefits by 13 percent. In addition to the surplus energy benefits cited above, other benefits may be available, such as opportunity sales, capacity sales, and reduced

line losses, which will increase the value of these additions. Furthermore, considerably more surplus Canadian energy could be transferred to California over the proposed additions.

An additional factor which might affect the quantity of surplus energy available is the future energy demand and supply picture in the Northwest. According to the most recent regional forecast, delays of planned resources are the largest cause of projected deficits--ranging from 2,000 to 4,000 average annual MW between 1980 and 1990. The following table shows the effect on the amount of additional surplus energy from the ranges of firm power deficits in the regional forecasts as well as with a deficit of 1,000 MW and with no deficit at all.

Size of firm power deficit (MW)	Amount of additional surplus (million kWh) (note a)	Annual Surplus Benefits (1990)	
		Oil savings (million bbls)	Value ($million) (note b)
0	4,760	7.9	271
1,000	3,490	5.8	199
2,000	2,170	3.6	124
2,685	1,620	2.7	92
3,000	1,380	2.3	79
4,000	1,260	2.1	72

a/Additional surplus energy available for transmission outside the Northwest.

b/ Assuming an average benefit of 57 mills per kWh.

Not clear at this time is whether, and to what extent, the region might experience a deficit. Note in the above table that should the currently projected "worst" case (4,000 MW) occur, an estimated additional 1,260 million kWh of surplus energy would still be available. This would still save over 3 million barrels of oil per year--(2.1 million from the Pacific Northwest sales and 1.8 million from Canadian hydropower). Bonneville, in a surplus energy analysis prepared for PG&E assumed a deficit of 2,685 MW, which would result in an estimated additional 1,620 million kWh of surplus energy from the Pacific Northwest each year. This in turn would save over 4 million barrels of oil per year when the

Canadian savings is combined with the Pacific Northwest savings. We also used this same mid-range assumption in our estimate of benefits on page 6. The d.c. upgrade and the third a.c. line would be able to handle an additional 1,620 million kWh of surplus energy (385 and 1,235 million kWh respectively). The second d.c. line could accommodate 570 million kWh, but it is uneconomical to build (assuming the upgrade, third a.c., and second d.c. line in this order of development).

ISSUES AFFECTING INTERTIE EXPANSION

While expanding the intertie could provide sufficient oil savings, several issues must be addressed before expansion can occur. First, uncertainty exists among some California utilities, who are parties to the proposed expansion, over whether benefits from expansion will in fact materialize. Second, there is the question of whether sufficient benefits will accrue to some of the parties involved in the expansion. In addition, there are also some institutional and legal issues which must be addressed.

Uncertainty surrounding benefits

Even though several studies have been made regarding intertie expansion, no consensus has been reached regarding the economics of further development. While rapid increases in the price of oil have dramatically improved the economics of expansion, growing uncertainties regarding the Northwest's ability to meet loads are creating increased doubt.

Recent Northwest load and resource forecasts have further clouded the issue by projecting deficits in the 2,000 MW to 4,000 MW range between 1980 and 1990. Such projections, if they occur, would tend to reduce the amount of surplus energy available for export. As shown on page 7 the amount of surplus available for export varies considerably under different Northwest deficit projections. If the Northwest does in fact experience deficits, Bonneville and Northwest utilities will seek ways to stretch their energy supplies. Because of these uncertain conditions, Southwest utilities are reluctant to make capital investments in additional interties, and Northwest utilities are cautious about supporting additional interties.

Several different bills have been proposed in the Congress in an attempt to help alleviate the Northwest's supply uncertainties. This proposed legislation, among other provisions, would allow Bonneville to underwrite the financing of construction and power supplies. Bonneville and Northwest officials believe when the Northwest energy situation is settled, there will be increased Northwest support for intertie expansion and less reluctance to enter into power sales agreements. Should the power bill fail

to be enacted, Bonneville points out it will need to allocate the limited Federal hydropower and believes the struggle over who should have access to it will continue to be a devisive issue in the Northwest.

How will benefits be allocated?

The second major question affecting intertie expansion is how benefits will be allocated. More precisely, will California utilities receive enough benefits to allow them to repay capital investments in intertie facilities. This issue becomes more or less acute depending on (1) the total amount of surplus available to the Southwest and (2) the differential in energy costs between the two regions. Considering the uncertainty discussed above, the allocation of benefits will be critical to whether utilities participate in financing line expansion. This is particularly true with regard to funding of the Northern California portion of the third a.c. line, currently under evaluation by PG&E.

The Northwest and California differ on how benefits from the sale of surplus energy should be allocated. The Northwest wants equal sharing in the differential in energy costs between the two regions. Bonneville recently introduced a "share-the-savings" rate, which has been in effect since December 1979. This rate, which is based on the concept of opportunity cost, is the difference between Bonneville's hydro production cost and California's displaced oil production cost which is then halved, up to a maximum rate of 20 mills per kWh. California utilities have sought intervention through FERC disagreeing with the "share-the-savings" concept. In addition, they are also concerned about the future cost of energy, particularly as cheaper hydropower in the Northwest is augumented with increasingly more expensive coal and nuclear-fired generation.

Assuming total benefits are sufficient to justify the d.c. upgrade and a third a.c. line, it is important not to allow the struggle over the allocation of benefits to block expansion. In order to minimize risk and facilitate expansion, it may be necessary to work out ahead of time a statement of principle detailing financial arrangements. Such a statement could require that whatever benefits accrue from the additional line capacity first be used to pay for the new intertie, with the remaining benefits accruing to the utilities involved in the energy transactions.

Other concerns

California private utility officials are concerned that additional interties might result in them losing power benefits to public utilities. This concern stems from the fact that preference in the sale of Federal power is first extended to

public entities. Public utilities in California are interested in intertie expansion and will probably seek to be a participant or buy capacity in any new lines. Since surpluses available from Bonneville must first be offered to public utilities to the extent they have line capacity, there may be times when the lines could be filled that private utilities would lose proportionatly some power benefits. This situation is compounded if one assumes a second d.c. line is constructed and power flows to Arizona and Nevada as well as California.

In addition, before further intertie development can occur, a Federal legal prohibition must be overcome. Existing Federal statutes 1/ prevent Federal funding or constructing of an intertie transmission facility that would connect to a system outside the the Northwest without congressional approval.

FEDERAL ROLE IN INCREASING INTERTIES

In August 1977 the Congress formed the Department of Energy and divided the responsibilities of the Federal Power Act between the Department and FERC. The Department then delegated its responsibilities to the ERA, except those in Title IV of the Department of Energy Organization Act. This reorganization also placed Federal agencies with power marketing responsibilities, such as Bonneville and Western, under the Department's jurisdiction.

The overall Federal responsibility for interconnections is with ERA, which has authority under the Federal Power Act (16 U.S.C. 202(c)) to order the construction of interconnections, but only under emergencies. This is interpreted by ERA to mean when power is disrupted or in danger of disruption. Thus, ERA doesn't have the authority, even in the national interest, to order an interconnection to be constructed to displace oil. ERA has not been involved in the studies or efforts to expand the intertie capacity between the Northwest and Southwest.

In addition to ERA's responsibility for interconnections, FERC is responsible for approving rates for inteconnection transfers. FERC is allowed under the Federal Power Act (16 U.S.C. 202b and 210) to order connection of electric utilities if it is in the public interest and would encourage overall conservation of energy or capital, optimize efficiency of use of facilities and resources, or increase system reliability. FERC has seldom ordered interconnections and has not made such an order since 1971.

1/16 U.S.C. 837g and 16 U.S.C. 838b(d).

CONCLUSIONS AND RECOMMENDATIONS

In addition to lowering electric rates in the Pacific Northwest and California, an annual average of over 4 million barrels of oil could be saved by expanding the intertie system between these areas. More than half the oil savings (2.7 million barrels) would result from the sale of surplus energy from the Northwest, while the rest (1.8 million barrels) would come from the sale of additional surplus energy from Canada.

Although past studies have identified savings, progress to achieve the savings has been slow. Concerns that have slowed the intertie expansion include uncertainty over future power availability and allocation of benefits, and the deliberations over Northwest power legislation. Unless these issues are resolved, a question remains over whether the oil savings will be achieved. To achieve this oil savings will require a closely coordinated effort between industry and the Federal Government--similar to the joint effort to construct the existing interties. While the Department has been involved in studies through Bonneville and Western, ERA has not been involved. Due to the many concerns and lack of a regional consensus, a more active ERA role may be needed to facilitate line development.

We, therefore, recommend that you direct ERA to

--monitor the progress of Bonneville's negotiations with California utilities to ensure all feasible agreements are reached to upgrade the d.c. line, and

--work with Bonneville and California utilities to facilitate development of the third a.c. line.

If, after a reasonable period, the above efforts are unproductive, you should seek congressional authority which would allow Western and Bonnneville to provide impetus for development.

In addition you should direct Bonneville and Western to study the need for a second d.c. line and ERA to monitor these studies to assure they are conducted on a timely basis. This is needed because growth and other factors are taking place in the Southwest and Northwest which might make this line beneficial.

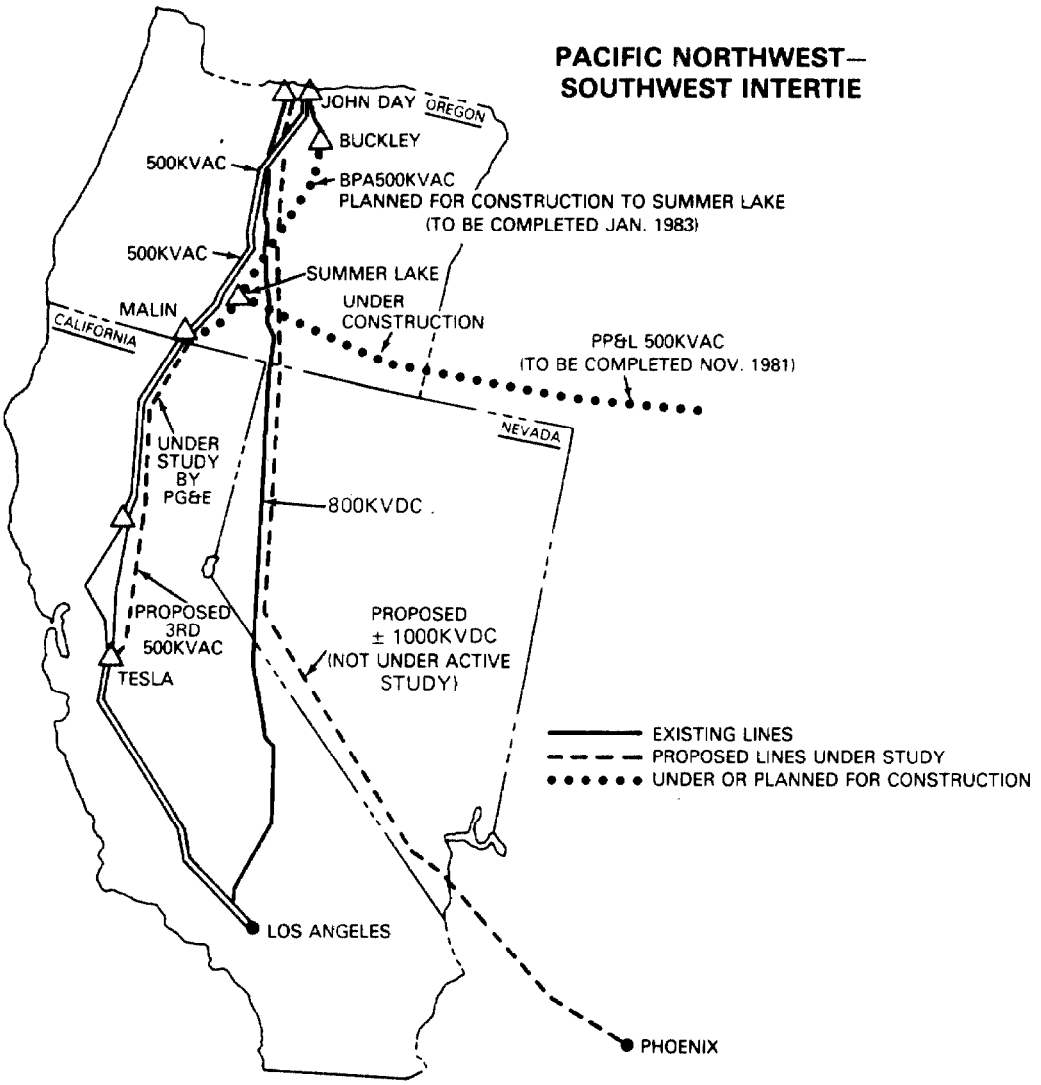
As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate

Committee on Government Affairs not later than 60 days after the date of this report, and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more then 60 days after the date of the report.

Sincerely yours,

J. Dexter Peach
Director

APPENDIX I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NEVADA
UNDER
STUDY
BY
PG&E
800KVDC
PROPOSED
3RD
500KVAC
TESLA
PROPOSED
± 1000KVDC
(NOT UNDER ACTIVE
STUDY)
EXISTING LINES
PROPOSED LINES UNDER STUDY
UNDER OR PLANNED FOR CONSTRUCTION
LOS ANGELES
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APPENDIX II

GLOSSARY

alternating current	An electric current that reverses its direction regularly and continually.
Alternating current line	Transmission line using alternating current (a.c.). Main features are: subject to continual flow reversal, higher unit transmission cost than d.c., designed for shorter distance transmission and more economical to tap, and line losses higher than d.c.
capacity	Maximum power output, expressed in kilowatts or megawatts. Equivalent terms: peak capability, peak generation, firm peakload, and carrying capability.
demand	In a utility context, the rate at which electric energy is delivered to or by a system, expressed in kilowatts, megawatts, or kilovolt-amperes over any designated period.
direct current	An electric current flowing in one direction.
Direct current line	Transmission line using direct current. Main features are: magnitude and direction of power flow controllable at all times, lower unit cost for long distance transmission (over 500 miles), terminals for d.c./a.c. conversion are very expensive making it uneconomical to tap, and line losses lower than a.c.

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energy	The ability to do work; the average power production over a stated interval of time; expressed in kilowatt-hours, average kilowatts, or average megawatts. Equivalent terms: energy capability, average generation, and firm-energy-load-carrying capability.
hydropower	A term used to identify a type of generating station, or power, or energy output in which the prime mover is driven by water power.
kilowatt (kW)	The electrical unit of power which equals 1,000 watts.
kilowatt-hour (kWh)	A basic unit of electrical energy which equals 1 kilowatt of power applied for 1 hour.
load	The amount of electric power delivered to a given point on a system.
loop-flow	In a looped transmission system the difference between the scheduled and the actual power flow at any point.
megawatt (MW)	The electrical unit of power which equals 1,000,000 watts or 1,000 kilowatts.
megawatt-hour (MWh)	A basic unit of power which equals 1,000,000 watts or 1,000 kilowatts.
power	The time rate of transferring or transforming energy; for electricity, expressed in watts. Power, in contrast to energy, always designates a definite quantity at a given time.
reliability	Generally the ability of an item to perform a required function under stated conditions for a stated period of time. In a power system, the

APPENDIX II

	ability of the system to continue operation while some lines or generators are out of service.
reserve capacity	Extra generating capacity available to meet unanticipated demands for power or to generate power in the event of loss of generation resulting from scheduled or unscheduled outages of regularly used generating capacity. Reserve capacity provided to meet the latter is also known as forced outage reserve.
secondary energy	Electric energy surplus to the needs of a supplier, the delivery of which may be interrupted for any reason by the supplier.
surplus energy	Electric energy generated at hydroelectric plants in the Pacific Northwest which cannot be conserved. This energy would otherwise be wasted because of the lack of market for it in the Pacific Northwest at any established rate. When the non-firm energy needs of the Pacific Northwest entities are satisfied, surplus energy then becomes available for marketing outside the Pacific Northwest.

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