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Analysis Of Estimated Cost For Three Pacific Northwest Nuclear Power Plants

This report analyzes the cost estimates for three nuclear powerplants being constructed by Washington Public Power Supply System in the Pacific Northwest and compares their estimated cost with estimates made by Ebasco, a national nuclear engineering and construction firm. The large difference between the estimates is because

--differences exist in the base construction period used to calculate power cost for the Public Power System (1972-1981) versus Ebasco (1978-1990) and

--the Public Power System enjoys benefits as a publicly owned entity and can borrow capital at half the rate assumed by Ebasco for an investor-owned utility.

The Public Power System's capital construction costs, however, are higher per unit than several investor-owned nuclear projects with comparable operating dates.

EMD-79-95
JULY 30, 1979

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

ENERGY AND MINERALS
DIVISION

B-114858

The Honorable James H. Weaver
United States House of Representatives

Dear Mr. Weaver:

In response to your request of March 8, 1979, we analyzed the estimated power costs for three net-billed nuclear power plants now under construction in the State of Washington by the Washington Public Power Supply System (WPPSS). WPPSS is a powerplant-construction agent, representing 22 publicly owned utilities in the Pacific Northwest. The primary focus of our work was to compare the estimated annual power generation costs for the WPPSS plants to the estimated costs of a typical nuclear powerplant as defined in an Ebasco corporation study. We gave particular attention to assessing the assumptions used by WPPSS in calculating these power costs. We also assessed the effect of various plant capacity factors on estimated power costs.

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RESULTS OF REVIEW

The WPPSS estimated bus-bar cost (annual power generation cost) is about 29 mills per kilowatt-hour (kWh) at its three "net-billed" projects. We believe this estimate is a reasonable reflection of annual power costs based on current WPPSS estimates 1/ of total project capital costs including financial costs, anticipated fuel cost, and expected operating and maintenance costs. WPPSS' low annual power generation cost estimate is primarily influenced by WPPSS' status as an agent for publicly owned utilities and Bonneville Power Administration's (BPA) agreement to purchase almost the entire capability of the three projects. This enables WPPSS to attain favorable financing and tax advantages that significantly lower the annual rate at which project capital construction cost is retired (the fixed-charge rate). For example, WPPSS' cost of borrowing is nearly 50 percent below that paid by investor-owned utilities. WPPSS is also exempt from most of

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1/WPPSS Revised 1979 Budget, January 1979.

the taxes and depreciation allowances that investor-owned utilities must consider in establishing rates for amortizing plant investment.

The large disparity between WPPSS' power generation cost estimate--28.6 mills per kWh--and the estimate Ebasco developed for a "typical" nuclear project--63.8 mills per kWh--occurs primarily because the Ebasco study does not use publicly owned utility assumptions in calculating power cost. Rather, the Ebasco study calculates bus-bar cost using investor-owned utility assumptions which are characterized by higher borrowing and tax costs. In our analysis of WPPSS and Ebasco costs, the WPPSS fixed rate was about 8 percent compared to nearly 17 percent for Ebasco. Thus, on a comparable basis fixed charges for amortizing its capital construction cost is about half the rate calculated for Ebasco's investor-owned nuclear projects.

Another factor contributing to the WPPSS and Ebasco power cost disparity is the dissimilarity in project construction periods used to calculate fixed charges. WPPSS fixed charges are calculated for plants which will be constructed between 1972 and the early 1980s. Ebasco's cost, on the other hand, is calculated for a plant being constructed between 1978 and 1990. The lack of any substantial period of overlap between the two construction periods all but negates a straight-across cost comparison. For comparison we adjusted Ebasco costs to the WPPSS construction period using an annual 7-percent inflation rate. This adjustment reduced the difference between WPPSS and Ebasco fixed charges by about 57 percent. Together, the differences in type of ownership and time assumptions used in WPPSS and Ebasco calculations account for most of the 35-mill difference in bus-bar costs.

WPPSS' fuel contracts will also provide much of the initial core and early reload fuel at prices substantially below market prices that Ebasco assumed. WPPSS estimated fuel costs for the three net-billed projects range from about $10 to $34 a pound of uranium, while Ebasco's study assumed a fuel cost of from $93 to $179 a pound. WPPSS' favorable fuel contracts for these three projects extend through 1990 for Washington Nuclear Project (WNP) No. 1, 1995 for WNP No. 2, and 1998 for WNP No. 3, when WPPSS will begin paying the current world market prices for uranium.

WPPSS entered into these fuel contracts in the early 1970s, before the price of uranium dramatically increased to its current level of about $44 a pound. If WPPSS experiences problems in obtaining delivery from suppliers at the contract price and if prices are increased to near market levels, this will have a significant impact on WPPSS' estimated fuel costs during the early years of operation.

WPPSS' publicly owned status, earlier construction period, and lower fuel prices provide a significant advantage in WPPSS' calculation of power costs. However, these advantages apparently do not extend to WPPSS' capital construction costs which are about $350 more for each kilowatt of plant size than Ebasco's plants. Therefore, a 1200-megawatt WPPSS plant would cost about $420 million more to construct than is estimated for a similar Ebasco project.

The large disparity in capital construction costs estimates between WPPSS and Ebasco appears to be borne out in actual experience. A comparison of WPPSS' capital cost for project Nos. 1, 2, and 3 to the costs for several United States investor-owned nuclear projects with comparable projected operating dates shows WPPSS' capital costs higher by about $600 per kilowatt. In addition, at our request the Federal Energy Regulatory Commission (FERC) developed cost estimates 1/ for a publicly owned nuclear power plant located in the Pacific Northwest similar to WPPSS project No. 2. FERC results show that the capital construction cost would also be about $600 per kilowatt lower or about 35 percent below WPPSS' current construction cost estimates.

While a comparison of project construction costs obviously reflect unfavorably on WPPSS, the comparison of WPPSS and Ebasco annual power generation costs is not as clear. In comparisons with both Ebasco and several investor-owned nuclear projects, WPPSS annual power cost was considerably lower. This lower cost is primarily a function of WPPSS'

1/Estimates were developed using the Concept V Computer Program developed jointly by Oak Ridge National Laboratory and United Engineers and Contractors. The concept V Computer Program is used by FERC to estimate the capital investment cost of new base load coal fired or nuclear power plants. This investment cost is then compared to hydroelectric power plant investment cost evaluations to see which is less costly.

financing advantage as a municipal borrower. For comparison, we eliminated WPPSS' municipal advantages to see how WPPSS would fare, in terms of annual power cost, had it been required to compete for financing, pay taxes, and account for depreciation as do investor-owned nuclear projects. The results again reflect poorly on WPPSS. As an investor-owned utility, annual power costs for WPPSS' project No. 2 would exceed expected power costs for an Ebasco project adjusted to the same construction period by about 12 mills per kilowatt-hour.

In addition to this hypothetical comparison, we also compared WPPSS' costs as a publicly owned utility to construction and power costs estimates for several publicly owned projects the Tennessee Valley Authority (TVA) is constructing in the same general time frame. In these comparisons WPPSS project construction cost estimates were about $900 per kilowatt higher and power costs were higher by about 7 to 13 mills per kilowatt hour.

In calculating annual power costs both WPPSS and Ebasco assumed a plant capacity factor of 70 percent. This 70 percent capacity factor appears to be a common industry index but, we believe, may be somewhat optimistic in light of the annual power generation experience of currently operating nuclear power plants and the frequency of unscheduled shutdowns. Based on our analysis of available data, it appears that a more realistic capacity factor would be 65 percent. Lowering the capacity factor from 70 to 65 percent increases the annual power cost for each WPPSS project about two mills.

OBSERVATIONS

While WPPSS' annual power cost estimates for the net-billed projects appear accurate and are reconcilable to Ebasco's invesvestor-owned project estimates, WPPSS significantly higher project construction costs are not as easily explained or justified. Construction costs for the three net-billed projects are currently estimated at about $2 billion each, making these projects among the most expensive under construction.

During the course of this review we ~~did not~~ no inquiry was made attempt to determine the reasons behind WPPSS' higher construction cost. The subject, however, has been the object of considerable debate and study over the last year. Reviewers of WPPSS costs have focused a great deal of attention for these high costs on the management of the projects. On the other hand, WPPSS

contends that the higher costs merely reflect higher regional labor rates, NRC required changes to initial design, unscheduled construction delays, inflation, and other factors outside management control.

Who or what is responsible for WPPSS' higher project construction costs is yet to be determined. We believe, however, that WPPSS was not unique in experiencing escalating costs due to inflation, construction delays, and required design changes. Officials at several of the investor-owned projects we contacted mentioned design changes, inflation, and work delays as factors increasing cost. With this commonality of increasing construction cost experience along economic, regulatory and scheduling lines, it appears that WPPSS' higher project costs are mainly attributed to regional or local site factors such as labor rates and design requirements. WPPSS officials recently initiated a study with one of its construction engineering firms to identify and compare WPPSS' regionally unique site factors to similar factors for nuclear projects under construction outside the Northwest Region. Results of this study should be available soon.

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Shortly after our review was completed, WPPSS submitted its 1980 budget for consideration and approval by the systems directors. Citing construction delays, low labor productivity, and construction fuel cost increases, the cost estimates for the three projects were increased about $1.1 billion over the revised 1979 budget. This increase will require additional WPPSS financing of about $250 to 500 million a project for the three net-billed plants.

As a result of the increased financing, project annual interest and amortization costs have been revised. In addition, WPPSS officials have also revised other annual project costs. Based on these changes WPPSS' estimates for annual project costs at the net billed plants are about 5 to 8 mills higher than previously reported bringing the cost to 34 to 37 mills.

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This review was conducted by visits to WPPSS and the Bonneville Power Administration (BPA). At these locations, we interviewed agency officials and examined and analyzed various documents. Because of the time limits, we did not attempt to verify the documentary evidence provided. We have no reason to believe the information is not reasonably accurate. The State auditor conducts both legal and financial

examinations and audits all supply system action's. Additionally, annual financial audits are performed by a National CPA firm.

We trust this report is responsive to your needs. We did not obtain formal comments on this report; however, it was discussed with BPA officials who generally agree with our analysis.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 7 days from the date of the report. At that time, we will send copies to interested parties and make copies available to others upon request.

Sincerely yours,

J. Dexter Peach
Director

Enclosure

ENCLOSURE 1

ANALYSIS OF WPPSS COST

The Washington Public Power Supply System (WPPSS) and the Bonneville Power Administration (BPA) have provided several different estimates of annual bus-bar cost (generation cost for one kilowatt-hour of plant operating capacity). These estimates reflect changes in base periods, capacity factors, and certain other factors that have resulted in the reporting of different annual bus-bar cost for WPPSS' three net-billed nuclear projects. The table below shows a comparison of two recent estimates used by WPPSS and BPA.

Comparison of Bus-Bar Cost Estimates For WPPSS' Three Net-Billed Projects

	Nuclear Project No. 1		Nuclear Project No. 2		Nuclear Project No. 3	
	WPPSS (note a)	BPA (note b)	WPPSS (note a)	BPA (note b)	WPPSS (note a)	BPA (note b)
	----------(mills per kilowatt hour)----------					
Fixed charges (note c)	21.1	19	21.7	18	20.5	19
Operation & maintenance	2.7	4	3.5	4	2.8	4
Fuel	10.7	7	7.5	4	8.1	7
Total annual cost	34.5	30	32.7	26	31.4	30

a/Letter from Managing Director, WPPSS, to Congressman Kazen, March 2, 1979; 70-percent capacity factor with annual power costs escalated to 1990.

b/Letter from Administrator, BPA, to Congressman Weaver, February 9, 1979; 75-percent capacity factor.

c/Annual cost to retire plant capital investment (principal and interest) over 35-year period.

ENCLOSURE 1

While there are differences between WPPSS and BPA power costs, they are reduced once the assumptions used in their development are identified and reconciled. For example, while BPA based their estimates on WPPSS inservice operating dates (1981, 1983, and 1984 respectively for Washington Nuclear Project (WNP) #2, 1 and 3), both WPPSS estimates have been escalated to different time frames. The estimates reflect annual power costs escalated to 1990. On the other hand, BPA estimates are an average of the first 15 years of escalated annual operating costs e.g. 1981 to 1995 for project No. 2. When WPPSS figures are prepared based on BPA's time assumptions, the estimated cost for the three plants is about 29 mills. In addition to the time frame differences, WPPSS and BPA also used different capacity factors--plant operating capabilities--to calculate costs. By making the adjustments to compensate for these differences in assumed operating periods and operating capacity, WPPSS and BPA bus-bar cost estimates for the three projects are very similiar.

Similar differences in assumptions also exist between WPPSS and Ebasco Services Incorporated (Ebasco) calculations of bus-bar cost and must be taken into account in making any comparisons.

COMPARISON OF WPPSS AND
EBASCO POWER COST ESTIMATES

The following table shows a simple comparison of bus-bar cost estimates that WPPSS and Ebasco developed.

ENCLOSURE 1

Comparison of WPPSS and

Ebasco Cost Estimates

	WPPSS WPN No. 2 (note a)	EBASCO
Plant cost (capital investment)	$1,585 per killowatt	$1,648 per killowatt
Annual power generation cost (bus-bar cost):		
Fixed charge	19.5	45.7
Fuel	5.7	16.3
Operation and maintenance	3.4	1.8
Total	28.6 mills per kWh	63.8 mills per kWh

a/In our analysis of WPPSS cost estimates, we have selected WPPSS' estimated annual cost of power for WNP No. 2 in 1984 as being most representive of estimated power costs for all three net billed projects. The WNP No. 2 project is closest to completion (1981), and by 1984, after 2 to 3 years of operation, the full impact of operation should be reflected in power costs.

Comparing the above estimates, WPPSS' annual power generation costs appear to be significantly below--less than half--the costs projected by Ebasco. However, several differences in the assumptions used to develop these two estimates considerably affect the compatibility of the estimates and prevent a straight comparison. These differences are in assumed project construction period, project ownership, and fuel cost.

Differences in project construction periods create an inequitable comparative base

Different construction periods were used to calculate costs for the WPPSS project and the hypothetical "typical" project in the Ebasco study. The estimated construction period for WPPSS spans from 1972 to 1981, while Ebasco as sumes construction occurs between 1978 and 1990. The

variance between these project construction periods requires some adjustment to make the projected cost estimates comparable.

The standard method for adjusting different cost estimates for time variances is to escalate or de-escalate costs to a common period, using the historic or expected inflation rate. Assuming a 7-percent inflation rate and adjusting for some WPPSS plant investment charges not included in Ebasco calculations, we de-escalated Ebasco's 1990 construction and power cost estimates to 1981.

Plant Cost and Annual Power Generation Cost Revised to 1981 Level

	WPPSS Project No. 2	Ebasco 1990
Plant cost	$1,585 per killowatt	$1,126 per killowatt
Annual power generation cost:		
Fixed charge	19.5	30.8
Fuel	5.7	6.1
Operation and Maintenance	3.4	1.8
Total	28.6 mills per kWh	38.7 mills per

As indicated in the above table, adjusting Ebasco cost estimates to the same operating period as WPPSS significantly reduces the gap between WPPSS and Ebasco power generation costs--from 35 mills to only 10 mills per kilowatt-hour. However, since WPPSS and Ebasco estimates are based on time frames separated by nearly a decade, we were concerned that adjustments for inflation alone would not account for all the differences over time in an industry that has experienced significant cost increases from regulatory and design changes in addition to inflation. Therefore, we attempted to improve the comparison by adapting a second estimate of Ebasco project and power generation cost drawn from the same Ebasco report that supplied cost estimates for a plant operating in 1990. The second estimate portrays a plant started in 1969 and completed in 1978. This provides considerable overlap to WPPSS construction period of 1972 to 1981 and requires only 3 years escalation.

In Ebasco's second estimate, the authors hypothesized that the construction cost of a nuclear project, estimated in 1969 for 1976-1978 operation, should have been between $266 and $913 per kilowatt. For our study we assumed that project construction experience during this time frame would probably result in costs nearer the top of the range. Escalating for the 3-year period 1978-81 at a 7-percent annual rate and adjusting for plant differences result in a revised plant cost of $1,322 per kilowatt and a annual power generation cost of about 44 mills per kilowatt hour.

It is unclear which revised Ebasco estimate is best for comparing to WPPSS estimates. However, the revised estimates are so close that choosing one over the other does not significantly effect the comparison. Rather than choose between the two, we have used both estimates in our comparisons to WPPSS costs. (See page 8.)

WPPSS' publicly owned or municipal status provides substantial advantages

In developing cost of power estimates, Ebasco assumed private investor ownership of the project. WPPSS, on the other hand, is a municipal corporation representing publicly owned utilities and as such enjoys certain tax and financing advantages unavailable to investor-owned utilities. These advantages include a lower interest rate on bonds due to their tax-exempt status and exemption from income and other taxes that apply to private corporations.

The advantages gained from being a publicly owned utility are best seen when comparing WPPSS' fixed-charge rate to the fixed-charge rate Ebasco uses to depict a "typical" investor-owned utility. The fixed-charge rate is the annual rate at which the total project construction cost--plant cost--is amortized over the estimated 35-year life of the project. As shown below, WPPSS enjoys a fixed-charge rate only half that projected by Ebasco for an investor-owned utility's nuclear project.

ENCLOSURE 1

Fixed Charge Rate Comparison

	EBASCO	WPPSS
Levelized return	.0923	.0754
Book depreciation	.0286	not applicable
Income tax	.0148	not applicable
Ad valorem tax	.0200	not applicable
Insurance, administrative, and general	.0110	.0060
Franchise tax	.0020	not applicable
Total	.1687	.0816

As the schedule shows, the difference in the fixed-charge rate is principally due to the debt retirement rate (levelized return and depreciation) and tax requirements.

The tax-exempt status assigned to WPPSS bonds considerably influences WPPSS' rate for retiring debts. This municipal status allows WPPSS to offer bonds at a substantially lower interest rate than most investor-owned utilities. For example, the WPPSS weighted average borrowing cost on bonds for the three net-billed projects is about 6.5 percent. In contrast, the Ebasco study assumes financing costs for a typical investor-owned utility project as follows:

--53 percent debt at 10.6 percent interest

--35 percent common stock at 15.5 percent interest

--12 percent preferred stock at 11.0 percent interest

The weighted average borrowing cost at the above rates is slightly over 12 percent, nearly twice the financing rate estimated for WPPSS.

In addition to the borrowing advantage gained through tax-exempt status, the marketability of WPPSS bonds for projects No. 1, 2, and 3 has also been enhanced by the top rating--triple A--given to these bonds by rating agencies. This rating is primarily due to BPA's agreement to purchase a large share of the capability of these projects whether or not the projects are completed or operating. This agreement essentially guarantees investors will be paid even

if the plants are never built. WPPSS also sells bonds that do not have BPA's backing. These bonds have been given a slightly lower rating,--single A--and currently (1979) are being sold with an effective interest rate about two-thirds of 1 percent higher (7.16 vs 6.5 percent) than bonds issued for one of the three projects backed by BPA.

WPPSS' status as a publicly owned municipal institution also provides exemption from the income, property (ad valorem), and franchise taxes which investor-owned utilities are required to pay. In our comparison, this tax advantage totals over 3-1/2 percent. All together, WPPSS' municipal status provides financing and tax advantages of about 8 percent over the fixed-charge rate Ebasco used in its profile of the investor-owned utility.

The following table compares (1) WPPSS' and Ebasco's estimated annual fixed charges during the 1981 plant operation and (2) the effect a change in fixed-charge rates has on the annual fixed charge.

Comparison of Fixed Charges
1981 Base

	EBASCO 1978	WPPSS WNP #2	EBASCO 1990
Cost of plant (dollars per kilowatt)	$1,322	$1,585	$1,126
Fixed-charge rate	.1687	.0816	.1687
Fixed charges (normal) (note a)	36.4	21	30.8
Fixed charges (all at WPPSS .0816 rate)	17.6	21	14.9
Fixed charges (all at EBASCO .1687 rate)	36.4	43.6	30.8

a/(mills per kilowat-hour at 70 percent capacity)

As indicated by the above table, WPPSS' annual cost advantage over Ebasco's annual cost exists only so long as WPPSS' fixed-charge rate is maintained substantially below that used

by Ebasco. When fixed charges for both WPPSS and Ebasco are calculated using the same fixed-charge rate, WPPSS' annual fixed charges are between 19 to 41 percent higher than Ebasco's estimates. This is due principally to WPPSS' higher plant construction costs.

WPPSS' relatively poor performance as a hypothetical investor-owned undertaking when compared to Ebasco's performance is somewhat reflected in the project experience of several investor-owned nuclear projects being constructed. These projects estimate total annual power generation costs at 19.4 mills and 45 mills per kilowatt-hour for nuclear projects completed in the 1981 to 1984 time frame (See enclosure 2). As a hypothetical investor-owned utility above, WPPSS' fixed charges of 43.8 mills per kilowatt-hour alone exceed most of these estimates.

WPPSS' early fuel contracts provide a significant advantage over present fuel market prices

WPPSS has several contracts covering the acquisition of fuel for operating the three net-billed projects through 1988. These contracts are estimated to meet full requirements for the uranium fuel concentrate necessary for operation through 1990 for project No. 1, 1995 for project No. 2, and 1998 for project No. 3. WPPSS entered into these uranium fuel concentrate contracts in the early 1970s at prices ranging from about $10 to $34 a pound--25 to 75 percent below the current world market price of $40 to $45 per pound of uranium.

In contrast, Ebasco assumes fuel concentrate prices of from $93 a pound to $179 per pound in calculating fuel cost. In addition, further disparity exists between WPPSS and Ebasco estimates due to the incompatible time frames used for calculating fuel costs. WPPSS fuel cost is based on an average of the costs for the first 15 years of plant operation beginning the first year of operation--1981, 1983, and 1984 for projects Nos. 2, 1 and 3, respectively. On the other hand, Ebasco averages fuel costs over a 10-year period beginning in 1990. The following table compares fuel cost estimates calculated using both WPPSS and Ebasco assumptions for different periods.

Comparison of Annual Fuel Cost (note a)

	WPPS			Hypothetical Ebasco
	Project 1	Project 2	Project 3	
	(mills per kWh)			
WPPSS ASSUMPTION				
15-year average beginning first year of operation	8.7 - 9.8	5.5 - 6.3	6.8 - 8.1	N/A
EBASCO ASSUMPTION				
10-year average beginning 1990	12.0 - 14.8	7.3 - 9.2	8.2 - 9.9	16.3

a/Low end of range is best estimate and high end is with contingency for higher use of fuel.

As shown, comparing WPPSS' 15 year average project fuel costs to Ebasco's projected fuel cost for a plant beginning operation in 1990 results in a significant cost disparity. However, once WPPSS' fuel costs are adjusted to the same basis as Ebasco's--10 years beginning 1990--the gap narrows. This is particularly true for project No. 1, for which favorable fuel contracts will expire about 1992. For projects Nos. 2 and 3, the effect of lower-cost uranium fuel contracts through 1995 and 1998 respectively helps hold down WPPSS' average fuel costs for the period by offsetting the higher fuel costs expected once these contracts expire.

The favorable uranium fuel contracts provide WPPSS a substantial advantage by keeping fuel costs of the net-billed projects at a lower level than the present fuel market conditions would allow. However, uranium supply contracts throughout the Nation have recently been subject to seller's requests for price renegotiations as a result of the nearly four-fold jump in the world price since 1974-75. Such requests have reportedly been made with respect to some WPPSS contracts for its nuclear projects. One WPPSS supplier did not properly confirm its intent to deliver but finally complied with the contract terms only after WPPSS filed a lawsuit in the U.S. District Court. The supplier's compliance was secured only after both parties agreed to a proposed stipulation which

provided that delivery and payment be without prejudice to any future claims, defenses, or counterclaims by either party.

WPPSS, of course, prefers not to change the contract prices for uranium, and as cited above legal actions are available to WPPSS to enforce present contract provisions. If the prices do change, however, this will have a significant impact on WPPSS' estimated fuel costs, particularly during the first years of operations when low-cost fuel is expected.

WPPSS' capacity factor may be somewhat optimistic

The plant capacity factor of the project must be anticipated in order to calculate the estimated bus-bar cost for a nuclear project. The plant capacity factor represents the fraction of design base energy available from a nuclear plant for planning purposes. Further, the planning capacity factor is an annual average based on average availability between refueling outages with a refueling outage scheduled at least once every calendar year.

In calculating bus-bar costs, both WPPSS and Ebasco assumed a 70-percent capacity factor which appears to be a common, but not unanimous, projection of plant operating experience for the industry. Based on our inquiries to operators of six nuclear projects similar to WPPSS, we found that three used a 70-percent capacity factor in calculating costs; two other operators were more cautious, using 65 percent; and one planned for a 75-percent factor.

The reasonableness of the projected plant capacity factor used by WPPSS, Ebasco, and others is best determined by examining the experience of currently operating nuclear power plants. The Nuclear Regulatory Commission (NRC) in reporting highlights of nuclear powerunits in the United States 1/ plots the average unit capacity experience for operating commercial nuclear plants for 1976, 1977, and 1978. The average unit capacity plots indicate that the mean of the average unit capacity experiences of all U.S. commerical nuclear power units was between 60 and 70 percent for all 3 years.

1/U.S. Nuclear Regulatory Commission Program Summary Report, NURGE-0380.

Based on the experience of these plants, the best estimate of a single capacity factor usable as a predictor of future experience is about 65 percent. The 65-percent capacity factor derived from NRC plots is reinforced by data reported in Nuclear Engineering International, which reported the annual capacity factor for U.S. operating nuclear plants to be 63.4 percent in 1977.

Based on this available achievement data, we believe that a 65-percent capacity factor presently provides a more realistic estimate of a nuclear unit's operating capacity. We recognize that many plants may operate at a higher achievement level than 65 percent. However, as the average suggests, many will also operate at a lower level, and we cannot predict on which side of the average WPPSS will land. We also recognize that as time progresses, operating achievement is likely to improve as a result of further operating experience. However, the increasing number of shutdowns experienced by many operating plants due to new regulatory and safety considerations appears to somewhat offset productivity gains once commonly enjoyed as a result of experience.

The effect of changes in the capacity factor on annual bus-bar (generation) cost is shown in the following table.

Impact of Different Capacity Factors On Cost of Power for WNP No. 2

	75 percent	70 percent	65 percent	60 percent
	(mills/kWh)			
Fixed cost	18.2	19.5	21.0	22.8
Operating and maintenance cost	3.2	3.4	3.6	3.9
Fuel cost	5.4	5.7	6.2	6.7
Total	26.8	28.6	30.8	33.4

As indicated, the impact of lowering the capacity factor from 70 to 65 percent increases annual generation cost about 2 mills per killowatt-hour.

ENCLOSURE 2

COMPARISON OF ESTIMATED CAPITAL AND POWER COSTS FOR SELECTED NUCLEAR PROJECTS

1980-90

	Projected operation date	Capital construction cost ($/kw)	Annual power cost (mills/kWh)	Company (note a) Plant (note b)
1980	3/80	650	27.8	Commonwealth Edison-LaSalle #1
	4/80	547	15.6	TVA-Sequoyah
	6/80	880	43.0	Detroit Edison-Enrico Fermi #2
	12/80	511	16.3	TVA-Watts Bar
1981	9/81	1,018	22.6	FERC (Computer model of NW nuclear project (see note c)
	9/81	1,585	28.6	WPPSS #2
	11/81	990	41.0	Pennsylvania Power Light-Susquehanna #2
1982	6/82	622	19.4	TVA-Bellefonte
	10/82	1,680	not provided	Duquesne-Light-Beaver Valley #2
	10/82	1,046	37.0	Union Electric-Callaway #1
1983	4/83	1,077	45.0	Public Service Company New Hampshire-Seabrook #1
	12/83	1,613	30.5	WPPSS #1
1984	5/84	761	36.0	Arizona Public Services-Palo Verde #2
	8/84	733	23.2	TVA-Hartsville
	12/84	1,570	29.9	WPPSS #3
	6/85	1,801	41.7	WPPSS #4
	85	1,230	30.3	Puget Power-Skagit 1
1986	1/86	758	24.5	TVA-Phipps Bend
	5/86	947	28.2	TVA-Yellow Creek
	6/86	2,010	41.7	WPPSS #5
1990		1,648	63.8	Ebasco Estimate

ENCLOSURE 2

a/All the companies listed--except for TVA, WPPSS, and FERC are investor-owned utilities.

b/Several plants cited are only one unit of a multiunit (2 or 3 plants) construction project. In those cases, capital and power costs represent the average cost for all units.

c/The Federal Energy Regulatory Commission (FERC) at our request developed estimated cost data for construction of a hypothetical publically-owned nuclear power plant in the Northwest using Concept V, a computer program developed by Oak Ridge National Laboratory and United Engineers and Contractors. The estimates developed represent costs for a plant similar in size and spanning the same construction period as WPPSS Project No. 2.

(008921)

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