REPORT TO THE CONGRESS

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

Status Of The Grand Coulee-Raver Transmission Line Project

Bonneville Power Administration
Department of the Interior

The Grand Coulee-Raver electrical transmission line is the first 500-kilovolt high-capacity double-circuit line constructed by the Bonneville Power Administration. This line will be part of the Nation's largest network of long-distance, high-voltage transmission lines and part of one of the world's largest transmission grids.

This report provides information on the need for the project, expected benefits, and changes in cost, schedule, and performance since the agency's budget presentation in 1972.

PSAD-76-167

AUG. 18, 1976

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-114858

To the President of the Senate and the
Speaker of the House of Representatives

This report describes the status of the Grand Coulee-Raver Transmission Line Project and suggests ways to improve the procurement of future similar major civil acquisitions of the Bonneville Power Administration.

Our review was made pursuant to the Budget and Accounting Act, 1921 (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Secretary of the Interior and to the Director, Office of Management and Budget.

Comptroller General
of the United States

Contents

ABBREVIATIONS

BPA	Bonneville Power Administration
GAO	General Accounting Office
KV	kilovolts
MW	megawatts

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

STATUS OF THE GRAND COULEE-RAVER TRANSMISSION LINE PROJECT
Bonneville Power Administration
Department of the Interior

D I G E S T

The Grand Coulee-Raver electrical transmission line is the first high-capacity 500-kilovolt double-circuit line constructed by the Bonneville Power Administration. The project was undertaken to serve growing needs for power and assure reliable service in the Puget Sound area of the State of Washington.

The line, 174 miles long, runs from Grand Coulee Dam in eastern Washington across the Cascade Mountains to the Raver Substation southeast of Seattle. It was over 50-percent complete at the time of GAO's review.

The Power Administration's current estimate of the final cost for the project is $103.6 million, $48.6 million greater than the original estimate submitted to the Congress in February 1972. The cost growth was caused primarily by the changes in the scope of work, escalation in the price of material, and increased construction contract costs.

This cost estimate excluded $1.2 million for materials and equipment available from projects and $11.7 million for related equipment provided by the Bureau of Reclamation. GAO is recommending that cost estimates provided to the Congress in the future identify all related project costs.

The Congress authorized construction of the Grand Coulee-Raver project in July 1972. The Power Administration expected to complete the project in October 1976. In April 1974, this target date was extended 1 year to October 1977 because of a shortage of funds resulting from increased costs. The agency currently expects to complete the project by October 1, 1977.

PSAD-76-167

The Grand Coulee-Raver line is being constructed with an initial load level capacity of about 2,800 megawatts instead of the ultimate planned capacity of 5,000 megawatts. The Power Administration plans to retain the loading of the line at 2,800 megawatts for the forseeable future because of a larger-than-expected increase in planned power generation in western Washington. If the construction of these facilities is delayed or eliminated, additional cross-mountain capacity will be required sooner. The cost to upgrade the capability of the Grand Coulee-Raver line to 5,000 megawatts is estimated at $14.8 million.

The Power Administration conducted tests on prototypes of the three standard tower designs. Some tests did not reach the ultimate design load, while others were canceled completely. The Power Administration then redesigned portions of the tower, but GAO noted that the redesigned towers had not been tested at the ultimate design load.

The Department of the Interior stated that such a test program would be unnecessarily expensive in light of experience that has shown success in the ability to predict the adequacy of the transmission line structures.

GAO believes that redesigned towers should be retested to assure that the ultimate design load can be obtained, particularly since the designs will be used repeatedly. Accordingly, GAO is recommending that the Bonneville Power Administration's future transmission tower test programs provide for testing redesigned items.

CHAPTER 1

INTRODUCTION

As part of our continuing effort to provide the Congress with information about major acquisition programs of civil agencies, we reviewed the Grand Coulee-Raver project of the Bonneville Power Administration (BPA), Department of the Interior. The main objective was to examine the status of the project's cost, schedule, and technical performance.

PROJECT DESCRIPTION AND PURPOSE

The Corps of Engineers, Department of the Army, and the Bureau of Reclamation, Department of the Interior, construct hydroelectric power plants in the Pacific Northwest.

BPA constructs major high-voltage transmission lines to distribute power over a 12,000-mile network in the States of Washington, Oregon, Idaho, Montana, and Wyoming. This network is a portion of the total northwest power system composed of BPA and public and private utilities which have joined to develop a single power system to meet the combined long-range needs of power users in the area. The Grand Coulee-Raver power transmission line is part of this power distribution network.

The power line, 174 miles in length, will extend from Grand Coulee Dam in eastern Washington to the Raver Substation, located about 35 miles southeast of Seattle. It is the first 500-kilovolt (KV) high-capacity double-circuit power transmission line to be constructed by BPA. Although the ultimate power-carrying capacity of the line is 5,000 megawatts (MW), the initial capacity will be about 2,800 MW.

This project basically consists of steel towers, electrical wire (conductor), and related equipment such as insulators. Also, high-voltage switching equipment is required at the Raver Substation, the western terminal of the Grand Coulee-Raver line. Switching facilities at Grand Coulee Dam are to be provided by the Bureau of Reclamation.

BPA awarded contracts to commercial companies for removal of low-voltage lines and construction of the new lines. The tower steel, conductors, and insulators are provided to the contractor as Government-furnished material. A contract was let in April 1976 for modification of the facilities at Raver Substation.

PROJECT JUSTIFICATION

BPA stated that the Grand Coulee-Raver project is required to serve growing demands for power in the Puget Sound area and to achieve the required minimum main system reliability.

A 1971 BPA study showed that between the years 1977 and 2000 the power flow across the North Cascade Mountains will increase from about 7,000 to 24,000 MW. To meet this demand BPA set a goal of providing 29,200 MW of capacity to the Puget Sound area on existing right-of-way.

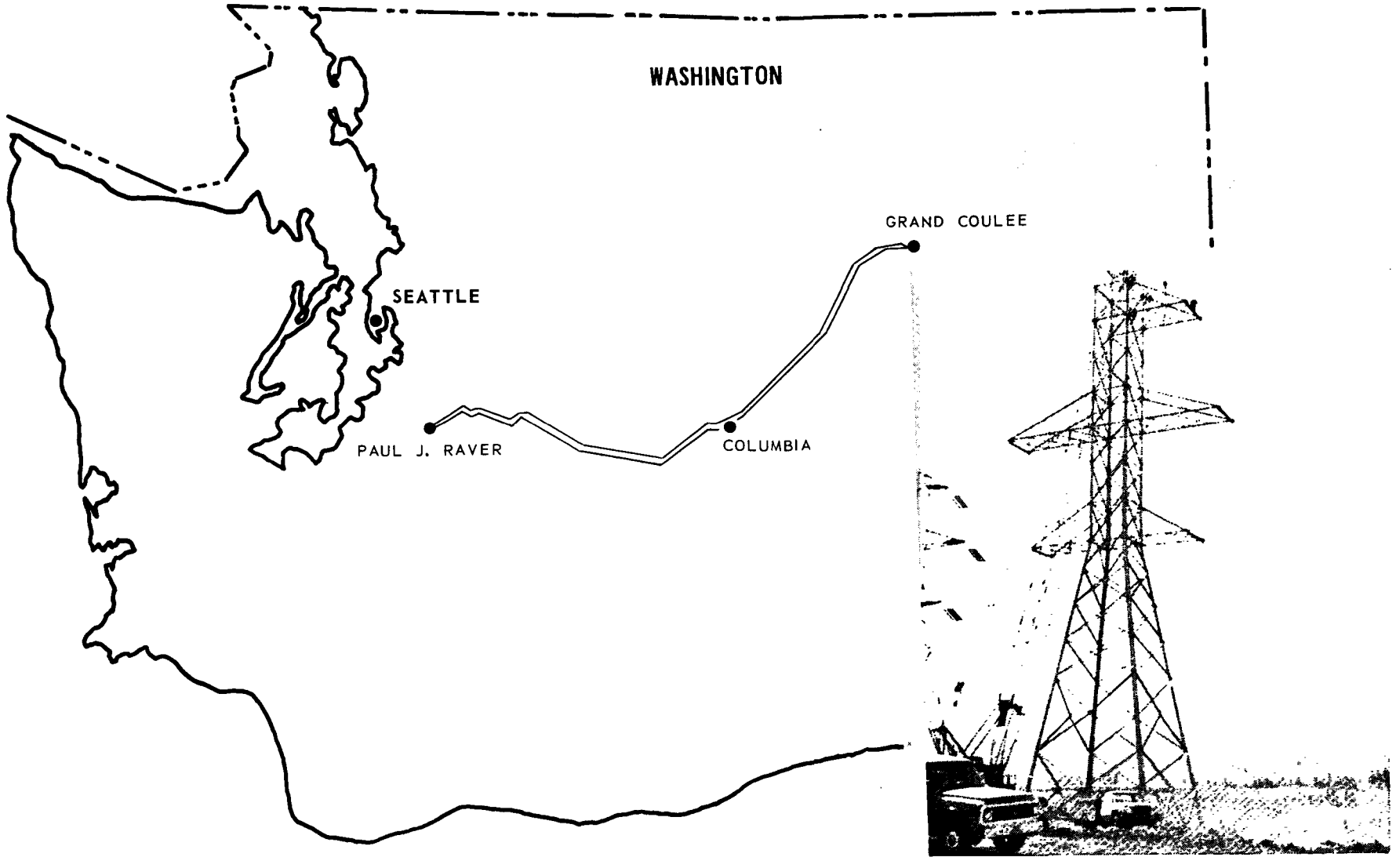
One plan considered five new double-circuit 500-KV lines with an ultimate capacity of 5,000 MW each, plus three existing 500-KV single-circuit lines with a total capacity of 4,200 MW, or a combined capacity of 29,200 MW. The Grand Coulee-Raver project was the first of these five 5,000-MW lines. A second 500-KV double-circuit line was projected for completion by January 1980, and three other 500-KV lines were projected for completion from about 1989 to 1997.

The first two lines under this plan were to have an initial load level capacity of 2,800 MW. Additional equipment, including series capacitors, would be required to bring the load level capacity up to 5,000 MW.

Since 1971, events have occurred which have reduced BPA's projected need for new power transmission lines across the Cascade Mountains to the Puget Sound area. In January 1976, BPA projected that only about 16,000 MW of capacity, not 29,200 MW as previously forecast, would be needed by the year 2000. This projection was based on a reduction in the estimated demand for power and the planned construction of two new nuclear plants in western Washington. As a result, BPA has decided to delay upgrading the load-level capacity of the first line and to postpone constructing a second line from Grand Coulee to the Puget Sound area.

PROJECT FUNDING

A change in the method of financing BPA construction and operation and maintenance costs has occurred since this project was approved in 1972. Costs were financed with appropriated funds into fiscal year 1975. BPA allocated a total of $91.4 million from congressional appropriations for this project. Effective October 18, 1974, the Congress authorized BPA to self-finance its activities. Accordingly, unexpended appropriations at October 18, 1974, and power marketing revenues



GRAND COULEE–RAVER TRANSMISSION LINE

received since that date have been the source of financing. BPA may also issue revenue bonds to finance construction costs, but none have been used to finance this project.

New major transmission facilities require separate approval by the Congress. The term "major" is defined as facilities intended to be used to provide services not previously provided by BPA with its own facilities.1/ BPA told us that since the Grand Coulee-Raver line replaced a previous line and was not being built in a new area, it is not the type of project that would require specific congressional approval.

SCOPE OF REVIEW

Our review was directed toward evaluating the status of the Grand Coulee-Raver project's cost, schedule, and performance. We interviewed BPA officials and examined planning documents, cost estimates, contracts, operating reports, and other records maintained by BPA. We also contacted principal construction contractors to determine the status of their work and to identify any important problems which could be emerging.

1/Defined in the Federal Columbia River Transmission System Act (October 18, 1974).

CHAPTER 2

COST

The estimated cost of the Grand Coulee-Raver transmission line since its approval by the Congress in 1972 has increased from a 1971 estimate of $55 million to $72 million in 1972 and to $103.6 million as of September 1975. Major reasons for this increase are:

--The change in project scope resulting when 73 miles of line, initially planned to be single circuit, were changed to double circuit.

--The economic effects of inflation which have greatly exceeded BPA's estimates.

The table on page 6 compares BPA's initial estimate with its first estimate in 1972, which includes a double circuit for the entire line, and with its most current 1975 estimate. As shown, the estimated cost of the line increased $17 million between 1971 and 1972 and an additional $31.6 million between 1972 and 1975.

REASONS FOR $17 MILLION COST INCREASE

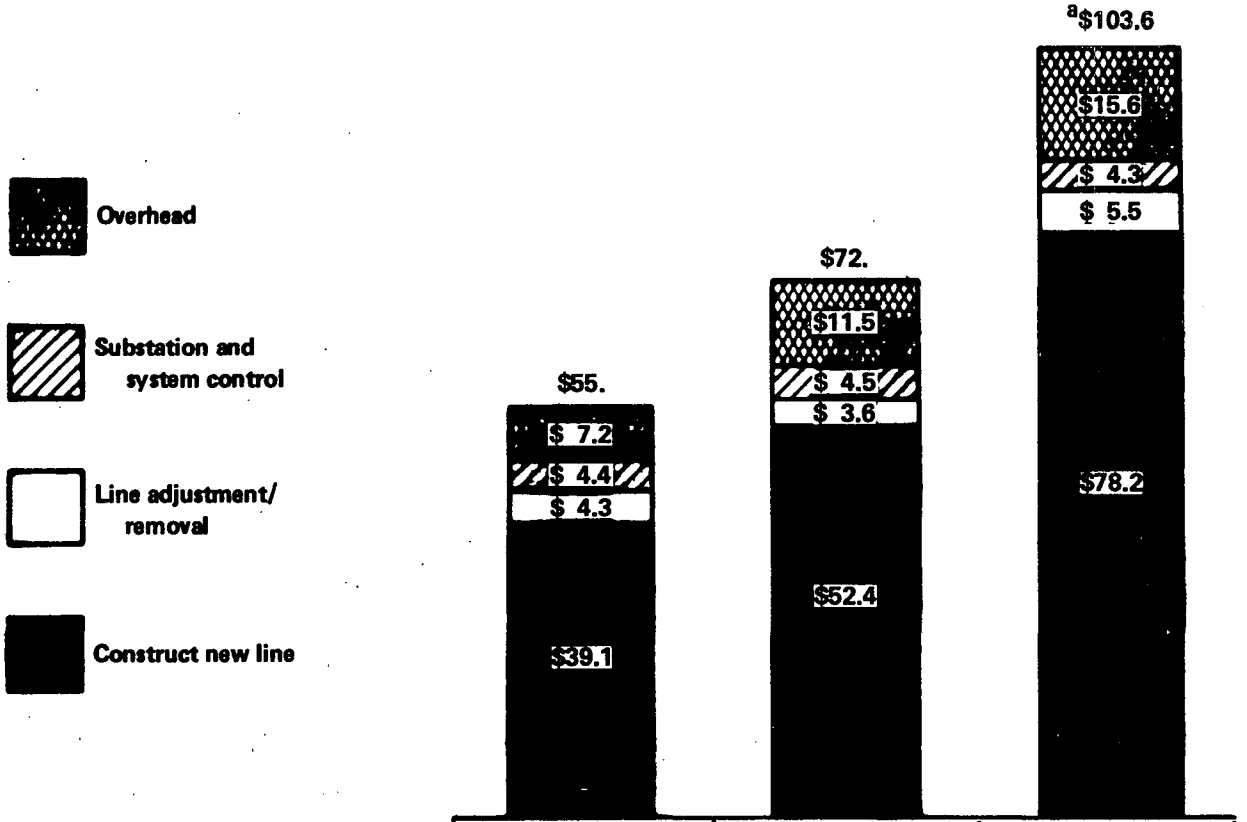
The major reasons for the $17 million increase in estimated line construction costs occurring between September 1971 and September 1972 are discussed below.

Scope changes

A change in the design of the transmission line increased estimated costs by $9.8 million. The design included in the September 1971 estimate of $55 million assumed that 73 miles of the line from the Grand Coulee to Columbia Substations would be single circuit and the remaining 101 miles to the Raver Substation double circuit. While no cost was included in this estimate, BPA planned to add a second 73-mile single-circuit line at some future date.

Later, BPA decided to change the line design to double circuit for the entire 174 miles. This was brought about because the Bureau of Reclamation accelerated by 2 years the addition of new generators at Grand Coulee Dam. BPA also decided that the higher costs of adding a second circuit at a

Increases In Estimated Cost To Construct The Grand Coulee-Raver Transmission Line (millions)



Date of estimate presentation to Office of Management and Budget	9–71	9–72	9–75
Miles of line (500 KV):			
Single circuit	73	–	–
Double circuit	101	174	174
Total	174	174	174
Scheduled energization	10–76	10–76	10–77

[a]Excludes $1.2 million of system material to be used in line construction (see p. 10).

later date could be avoided by going to a double circuit at this time.

One other change in the scope of work involved the removal of existing transmission lines. The 1971 cost estimate included $1,728,000 to remove two existing 230-KV transmission lines from the Grand Coulee to Columbia Substations (73 miles). The later estimate only included removal of one of these lines at a cost of $786,000, a cost decrease of $942,000. A BPA official informed us that they had initially intended to retire both lines but later decided to retain one when it was found the additional right-of-way was not needed. The retained 73 miles may later be removed when another high-capacity line is constructed.

Increase in overhead and other changes

An increased estimated cost of $4.3 million in overhead was caused by an increase ($2.2 million) in charges against which the overhead percentage rate is applied and an increase ($2.1 million) in the estimated overhead rate. Other changes of $3.8 million were not analyzed.

REASONS FOR $31.6 MILLION COST INCREASE

Between September 1972 and September 1975, the estimated cost of the line increased an additional $31.6 million, from $72 million to $103.6 million. (See p. 6.) The majority of this increase is attributed to changes in price levels, nature or scope of work, and overhead cost, as discussed below.

Changes in price levels

Price level changes account for $25.2 million of the additional project costs, $17.6 million because of higher material prices and $7.6 million because of higher construction contract prices.

Material prices

Since September 1972, the three major types of materials used in constructing the transmission line--conductor, insulators, and steel--have all recorded large price increases. As the following table shows, the average prices paid by BPA to obtain these materials has increased by 116, 75, and 32 percent, respectively, over the forecast in 1972, resulting in a $17.6 million growth in project costs:

Price Effects on Major Materials Used in the Line

Type of material (units)	Average unit price 9-72 estimate	Average unit price Actual	Percent increase	Cost because of price increase
				(millions)
Conductor (feet)	$ 0.63	$ 1.36	116	$12.5
Insulators (each)	10.86	19.05	75	1.8
Steel (tons)	335.00	442.00	32	3.3
				$17.6

Conductor prices showed the largest percent of increases and also had the greatest effect on project costs. Conductor contracts contain price escalation clauses which provide for determining price at the time of shipment. BPA officials said that they had to include escalation features in the contracts because rapid inflation at that time made potential bidders unwilling to enter into fixed-price agreements.

While steel prices increased the least, 32 percent, they caused a $3.3 million growth in project costs. The smaller increase in steel prices compared to conductor prices reflects the fact that the steel was obtained through fixed-price contracts entered into much earlier--late 1972 and early 1973--before the period of rapid inflation starting in about mid-1973.

While insulators were also obtained on a fixed-price basis, nearly one-half of them were not contracted for until October 1974. By then, the average unit price had increased, raising the average insulator unit price for the project to just over $19.

Construction costs

Increases in construction costs account for a $7.6 million growth in project cost. These increases are associated with erection of transmission towers on the new 500-KV lines and removal of existing 230-KV lines in the right-of-way.

In September 1972, BPA estimated the cost of constructing steel transmission towers at $336 per ton. The price of this work will average about $542 per ton, an increase of $206 per ton (61 percent). This price level change accounts for about

$6.4 million of the growth in project costs.

BPA's September 1972 project cost estimate included about $2.7 million for removal of existing 230-KV lines between Grand Coulee and the Raver Substation and about 10 miles beyond to the Covington Substation. The contract price for removal of these lines was about $3.9 million. This increase of $1.2 million is because of price level changes affecting several of the operations involved in the removals.

Changes in nature or scope of work

Changes in the nature or scope of work account for about $2 million in additional project costs. The most important changes are summarized below.

Increased use of steel in towers

In September 1972, BPA estimated that 29,765 tons of steel would be required for towers on the line. However, 32,432 tons were purchased, or about 9 percent more than predicted in 1972. BPA officials said this is because the agency had not previously constructed the types of towers involved and in 1972 had only preliminary designs from which to develop weight estimates.

The increased amount of steel accounts for $2.2 million of the growth in project costs. This includes $1 million of additional material costs and $1.2 million of increased construction contract costs.

Reduced road construction

BPA's September 1972 estimate included construction of new access roads and widening of existing access roads on the western portion of the line. The amount of this work actually contracted for was substantially reduced, resulting in a decrease in project costs of about $0.8 million.

Addition of new work items

Among the items not included in the September 1972 estimate are road work on the eastern portions of the line, changes to

the Grand Coulee-Chief Joseph No. 3 line near the Grand Coulee Substation, and relocation of two lines entering the Raver Substation. In total, new work items account for about $0.6 million in project cost growth.

Change in overhead costs

Since September 1972, estimated costs have increased $27.5 million. The overhead rate used in the September 1972 estimate was 19 percent, while the actual rate applied was 17.7 percent. The net effect of these factors is an increase in overhead costs of $4.1 million.

Changes in other factors not analyzed

The remaining $0.3 million of cost growth for the project is because of changes in a number of other factors which we did not evaluate.

COST ESTIMATES

In reviewing BPA's most current cost estimate for the line, dated September 1975 and totaling $103.6 million, we found that the estimates presented to the Congress on the Grand Coulee-Raver transmission line did not disclose the costs of system materials used in construction.

BPA cost estimates presented to the Congress did not contain $1.2 million for materials. According to BPA officials, these costs were not included because they were for material and equipment included in previous projects that have since been taken out of service and therefore did not require additional appropriated funds.

While modifications to the Raver Substation are being made by BPA and are included in the estimated total project cost of $103.6 million, this estimate does not include the cost of switching facilities at Grand Coulee Dam which are being provided by the Bureau of Reclamation and are estimated to cost about $11.7 million.

CONCLUSION AND RECOMMENDATION

BPA did not include all project and project-related costs in its estimate provided to the Congress. We believe that the Congress should be aware of related project costs, and therefore we recommend that the Secretary of the Interior direct that the Administrator of the Bonneville Power Administration

take steps to assure that its cost estimates provided to the Congress for future construction projects identify all related project costs.

CHAPTER 3

SCHEDULE

The Congress authorized construction of the Grand Coulee-Raver project effective July 1, 1972. BPA initially expected to complete the project and energize the line in October 1976. In April 1974, this target date was extended 1 year to October 1977. The principal reason for this schedule delay was a shortage of funds (obligational authority) resulting from an escalation of material and construction costs. In 1974, rapid price increases resulted in BPA not having sufficient obligational authority for the year to maintain its scheduled rate of construction. Consequently, the decision was made to delay some projects, one of which was the Grand Coulee-Raver line. The lack of such authority should no longer be a problem, however, since BPA is now authorized to self-finance its activities.

REVISED SCHEDULE

BPA expects to complete the project by the revised scheduled completion date, October 1, 1977. Line construction work was divided into four sections, with one contract for each section. In December 1975, work on all four construction contracts was progressing satisfactorily and, based on elapsed contract time, was ahead of schedule. The following table compares the percent of total work completed to the percent of total contract time which had elapsed as of December 5, 1975.

Section	Percent of Contract time elapsed	Percent of Work completed
I. Grand Coulee-Falls Lake (32 miles)	17	21
II. Falls Lake-Columbia (41 miles)	17	33
III. Columbia-CleElum (50 miles)	44	82
IV. CleElum-Raver (51 miles)	44	77

As the table shows, sections III and IV across the Cascade Mountains were 82 and 77 percent complete although only 44

percent of the total contract performance time had elapsed. These two are the most difficult sections and account for 101 miles of the 174-mile project length. The table also indicates that contract work on sections I and II is ahead of schedule. Because these sections of the line are being constructed over relatively flat terrain, the contracts were awarded later than those for sections III and IV. The last contract--for modification of the Raver Substation--was awarded on April 9, 1976, with completion scheduled for December 8, 1976.

CHAPTER 4

PERFORMANCE

We reviewed project performance characteristics relating to reliability, capacity, and testing.

RELIABILITY

BPA justified the Grand Coulee-Raver project on the basis that it was necessary to meet established minimum main system reliability requirements. These criteria are established by BPA and according to BPA comply with the standards generally accepted throughout the industry as constituting prudent utility service.

Reliability can be defined and measured in terms of performance of a system under stress. The agency recognizes that 100-percent-reliable service can never be obtained regardless of the effort or money expended. Accordingly, its goal is to obtain maximum reliability at an affordable price.

BPA plans its main grid transmission system to carry all loads when momentary interruption of a major transmission facility into an area occurs at the same time that another transmission facility into the same area is out of service, for maintenance or whatever reason.

Based on stability studies, BPA determined that the existing system could not satisfy minimum reliability criteria during the winter of 1976-77. For example, the study showed that if a momentary outage of a major line to the Puget Sound area coincided with another major line to this area being out of service, the result would be instability--cascading outages and separation of the Seattle area from the rest of the system. BPA determined that energization of the new Grand Coulee-Raver line by October 1976 would permit compliance with its reliability criteria.

Although the Grand Coulee-Raver line will not be in service until October 1977, BPA officials stated that they will meet the agency's minimum reliability criteria during the winter of 1976-77. They said that present studies, using a decreased load, coupled with improved generator exciters and faster circuit breakers, indicate stable operation for this period without the Grand Coulee-Raver line.

It is possible that power to the Puget Sound area would be disrupted if one of the Grand Coulee-Raver transmission

towers went down (causing the loss of two 500-KV circuits) while another major cross-mountain line was out of service. BPA told us that the impact of losing both circuits of the Grand Coulee-Raver line depends on system conditions and line loading at the time.

CAPACITY

In the fiscal year 1973 preliminary budget presentations to the Office of Management and Budget, BPA stated that the Grand Coulee-Raver line was designed to have an ultimate load level capacity of 5,000 MW. BPA initial loading level of the line, however, will be about 2,800 MW. BPA expects to increase the capability of the line to 5,000 MW by the addition of series capacitors 1/ as loading increases. BPA's current estimate of the cost to upgrade the Grand Coulee-Raver line to 5,000 MW is an additional $14.8 million.

This delay in the upgrading of the line resulted because of a projected decrease in cross-mountain loading brought about by the larger-than-expected increase in planned power generation in western Washington, including the planned nuclear plants at Satsop and Skagit. If the construction of these facilities is delayed or eliminated, additional cross-mountain capacity will be required sooner.

TESTING

A major component of an electrical transmission line is the towers which support the conductor. Steel towers are designed by BPA using the National Electrical Safety Code as a guide. BPA applies additional standards to meet its needs for basic wind and weather conditions.

Tests were conducted under contract on prototypes of the three standard tower designs. Loads were applied by the test contractor to determine the strength of the structure under various conditions. The test loads were to be applied in increments up to the ultimate design load.

We noted that some tests were canceled and others were not made at the ultimate design load. This occurred when

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1/Equipment which compensates for voltage drop along a line, thereby improving its power-carrying capabilities.

steel tower members had failed or a failure appeared imminent. For example, five tests were run on the standard dead end tower with the following results.

--One test was successful.

--Two of the tests were discontinued before reaching the ultimate design load because bracing members were bowed.

--In another test a bracing member failed completely at 90 percent of ultimate design load.

--In the final test, a major leg failure was imminent, so BPA accepted the test as satisfactory and applied no further increase in load.

Based on some of the tests, BPA redesigned portions of the tower; however, we noted that the redesigned towers had not been tested at the ultimate design load.

Concerning the complete test program, BPA officials told us that such a test program would be unnecessarily expensive and that tests were curtailed to preclude damage to the structure and to avoid further delay in completing the project.

BPA officials also said that they either satisfied themselves that the load strength of the towers as tested was adequate or they redesigned the steel members to meet design performance criteria. They assured themselves that the redesign was adequate by using computer models to test the changes. Further, they said that they are confident that the structures are completely reliable.

CONCLUSION AND RECOMMENDATION

Prudent management suggests that during a test program redesigned items be retested to assure that the ultimate design load can be obtained, particularly when, as is true in this situation, the tower designs are expected to be used repeatedly. We realize that this retesting would cause added costs; however, we believe these costs would be minor in relation to the possible costs of retrofitting defective towers after construction. Therefore we recommend that the Secretary of the Interior direct the Administrator of the Bonneville Power Administration to have redesigned items tested in future BPA transmission tower test programs. Also, BPA should allow adequate time for the test program so that retesting will not create delays in the completion of the project.

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JUN 10 1976

In Reply Refer To:
EBP

Dear Mr. Eschwege:

Following are the Bonneville Power Administration's comments on the General Accounting Office Draft of Staff Study on EBP Grand Coulee-Raver Transmission Line Project.

The summary should indicate the Grand Coulee-Raver transmission line is BPA's first high-capacity 500-kV double-circuit transmission line. BPA has previously built two short sections of lower-capacity 500-kV double-circuit lines.

On pages 2, 5, 10 and 23, initial as constructed capacity of the line is given as 2800 MW. This is not correct and should be clarified. The Grand Coulee-Raver line is designed for 5000 MW, but initial loading is expected to be between 2000 and 3000 MW varying with system conditions, such as load levels, generation in service and relative impedance of the transmission system in parallel with the line. As line loading increases to about 3000 MW, series capacitors will be added in order to achieve optimum economic loading at the 5000 MW level. The series capacitors may be added all at once or in two steps depending on the rate of growth of line loading.

The last paragraph on page 4 should indicate BPA's 12,000-mile network is in the States of Oregon, Washington, Idaho, Western Montana and Western Wyoming. BPA has not constructed facilities in Utah, Nevada or California.

The second sentence of the second paragraph on page 5 should read "Also, high voltage switching equipment is required at Raver Substation, the western terminal of the Grand Coulee-Raver line."

The third paragraph on page 5 should show the construction of the new line is on the right-of-way vacated by contract removal of existing lower voltage lines.

APPENDIX I

Ltr. to Mr. H. Eschwege, Subj: Comments on GAO Draft of Staff Study on EBP Grand Coulee-Raver Transmission Line Project

The last paragraph on page 6 should state "In January 1976, BPA projected about 16,000 MW of capacity, not 29,200 MW as previously forecasted, would be needed by the year 2000."

The first full sentence on page 7 should state "As a result, BPA has decided to delay installation of series capacitors and to postpone constructing a second line from Grand Coulee to the Puget Sound area." (Raver Substation would not necessarily be the western terminal for the second line.)

The second major reason given for the increased cost of this project shown on page 9 could be misinterpreted to mean BPA includes future inflation in their estimates, even though on page 17 it is stated BPA does not.

In Table 1, page 10, the "Load Capacity" should read "Design Capacity" with the following values: 9/71, 2500 MW[b]; 9/72, 5000 MW; 9/75, 5000 MW, with footnote (b) reading "Limited by single-circuit section."

The fifth line on page 24 should read " . . . capacity will be required sooner."

On pages 5 and 20, reference is made to award and completion schedules for contract construction of Raver Substation facilities. A contract for this work was let April 9, 1976, and the contract completion date is December 8, 1976.

The Testing section which begins on page 24, criticizes the test program for not testing all redesigned items in transmission towers. Such a program would be unnecessarily expensive. BPA's test program is part of an effort to optimize a towers design and keep the quantity of steel to an absolute minimum. This is especially important for those designs which will be used repetitively throughout a long line. The tests are used to verify computerized tower designs and to check a vendors fabrication details. As a result, the on-site test engineer has several engineering judgements to make regarding the test in addition to the one cited regarding the loading at which failure occurred. Experience

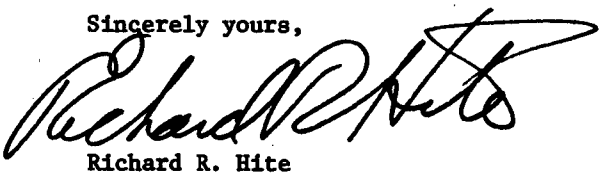
APPENDIX I

Ltr. to Mr. H. Eschwege, Subj: Comments on GAO Draft of Staff Study on EBP Grand Coulee-Raver Transmission Line Project

has shown success in the ability to predict the adequacy of strength for transmission line structures.

We appreciate having had the opportunity to review the subject draft.

Sincerely yours,



Richard R. Hite
Deputy Assistant Secretary - Management

Mr. Henry Eschwege
Director, Community and Economic
Development Division
General Accounting Office
Washington, D.C. 20548

GAO note: Several comments refer to material not included in our final report. Other comments were incorporated where appropriate. Page references refer to our draft report and may not correspond to the pages of this final report.

APPENDIX II

PRINCIPAL OFFICIALS OF THE DEPARTMENT OF THE INTERIOR

RESPONSIBLE FOR THE ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
SECRETARY OF THE INTERIOR:		
Thomas S. Kleppe	Oct. 1975	Present
Stanley K. Hathaway	June 1975	Oct. 1975
Kent Frizzell (acting)	May 1975	June 1975
Rogers C. B. Morton	Jan. 1971	May 1975
Fred J. Russell (acting)	Dec. 1970	Jan. 1971
Walter J. Hickel	Jan. 1969	Nov. 1970
ADMINISTRATOR, BONNEVILLE POWER ADMINISTRATION:		
Donald P. Hodel	Dec. 1972	Present
Henry R. Richmond	Sept. 1967	Dec. 1972