APPENDIX B

THE REPAYMENT PROGRAM

1. REPAYMENT PROGRAM OPERATION

1.1. Purpose

The major purpose of the repayment program is to determine, consistent with applicable Federal statutes and RA 6120.2, whether a given set of annual revenues is sufficient to repay with interest the long-term investment and obligations of the FCRPS. The program calculates amortization and interest when determining the minimum revenue level necessary to recover FCRPS Federal investments and obligations.

1.2. Computation of Revenues Available for Interest and Amortization

Given a set of revenues and expenses for each year, a set of annual revenues available for interest and amortization can be obtained by subtracting noninvestment-related expenses such as O&M expense, purchased power, and exchange costs from revenues (equation 1 below). This revenue subset can then be used to make interest expense and amortization payments on FCRPS-related appropriations and bonds.

(1) revenues available for interest and amortization$_i$ =

$$\text{revenues}_i - \text{expenses}_i, \qquad i=1,2,...,n,$$

where n is the total number of years in the study.

1.3 Computation of Revenues Available for Amortization Payments

For each year, the revenues available for interest and amortization, less interest expense, are used to make amortization payments on the Federal investments and obligations (equation 2 below). It should be noted that the repayment program recognizes the unique nature of each of the Federal investments and obligations in the FCRPS. The program uses data for approximately

1,700 specific investments for generation and approximately 500 specific investments for transmission. The project name, amount of principal, interest rate, in-service date, due date, and the nature of the investment are described for each investment.

(2)   revenues available for interest and amortization$_i$ -

$$\text{interest expense}_i = \sum_{j=1}^{m} \text{amortization payment}_{ij}, \qquad i=1,2,...n,$$

where m is the total number of Federal investments.

1.4. Computation of Principal Payments Given Due Dates

The amortization payments on each investment must total the investment's principal on or before its due date (equation 3):

(3) $$\sum_{i=1}^{n} \text{payment}_{ij} \leq \text{principal}_j, \qquad\qquad j=1,2,...m.$$

1.5. Ordering of Payments According to Highest Interest First Constraint

The process described above yields one set of equations in which the payments are summed by year and another set of equations in which the payments are summed by investment. Taken together, however, these two sets of equations have no unique solution. RA 6120.2 suggests an approach to a unique solution with the requirement that "[t]o the extent possible, while still complying with the repayment periods established for each increment of investment and unless otherwise indicated by legislation, amortization of the investment will be accompanied by application to the highest interest-bearing investment first."

A new equation can be obtained for each year by adding together equation 2 for that year and all earlier years. This equation sums all amortization payments made on any investment that comes

due in those years. This equation can be simplified by substituting the principal of each such investment for the sum of the amortization payments on that investment as given by equation 3. The resulting equation (equation 4 below) indicates that for any year the sum of amortization payments on investments that are not due by that year cannot exceed the sum of the revenues available for interest and amortization less the accumulated interest expense and the accumulated principal of all investments that are due in, or prior to, that year.

$$(4) \quad \sum_{i=1}^{k} \text{revenues available for interest and amortization}_i$$

$$- \sum_{i=1}^{k} \text{interest expense}_i - \sum_{\text{due}}^{k} \text{principal}_j = \sum_{\substack{\text{not} \\ \text{due}}} \sum_{i=1} \text{payment}_{ij}, \quad k=1,2,\dots,n.$$

The term "<u>due</u>" refers to Federal investments or obligations due to be repaid in or prior to the year k, and "<u>not due</u>" refers to Federal investments or obligations not due to be repaid by the year k.

For each year in the repayment study, the right side of equation 4 represents the amount of the accumulated amortization payments on Federal investments or obligations that are not due. The left side of the equation represents the accumulated revenues available for making these payments on the Federal investments or obligations. These amortization payments will first be made on the highest interest bearing Federal investments or obligations in compliance with RA 6120.2. If for some future year this amount is evaluated as being zero or negative, then this equation implies that amortization payments can be made only on highest interest bearing Federal investments or obligations that come due on or before that year.

1.6. Iteration Towards A Solution

Equations 2 through 4 do not permit a direct solution. Although the revenues and the Federal investments or obligation that are due are known for all years, an amortization payment made in the current year will affect interest expense in future years. That is, interest expense will no longer have to be paid on the portion of the Federal investment or obligations that has been amortized. This problem is solved using an iterative approach.

The program initially assumes no future interest expense in evaluating the left side of the fourth set of equations. Consequently, the net revenues available for payments on Federal investments and obligations that are not due, but bear the highest interest rates, will be excessive. As payments are determined for each successive year, and the interest expense of a given year is calculated, they are used in the fourth set of equations for all later years. The fourth set of equations is thus modified, and the revenues available for payments on "not due" highest interest rate bearing Federal investments or obligations are reduced. Therefore, the amortization of a Federal investment or obligation on its due date, in order to satisfy equation 3, may violate equation 2. Equation 2 may be violated when a negative balance occurs. A negative balance will result when revenues available for interest and amortization are less than interest expense plus any amortization payments that are due. As a result, a second iteration is necessary.

In the second iteration, the interest expense developed in the first iteration is used in the fourth set of equations for future years. Since amortization payments on "not due" highest interest rate bearing Federal investments or obligations were excessive in the first iteration, the interest expense developed in the first iteration will be less than the true interest expense. These estimates, however, are more accurate than an estimate of zero interest expense and, as a result, the negative balances will be reduced.

If revenues are sufficient to recover a given set of annual expenses and to repay with interest BPA's long-term Federal obligations, then the interest expenses of successive iterations will converge and the negative balances will be reduced to zero and thus yield a solution. Under these conditions all four equations will be satisfied.

If revenues are insufficient, then compliance with the fourth set of equations will force amortization payments on the highest interest rate bearing obligations to be delayed. This will cause an increase in interest expense, leaving less revenue available to amortize high interest obligations. The interest expense from successive iterations will diverge, and the negative balances will start increasing. Under these conditions no solution is possible given available revenues.

BPA does not deliberately plan to defer annual expenses in the future. Therefore, if revenues were insufficient to cover annual expenses for any year of the repayment period, the program decides that no solution is possible at that revenue level.

2. DETERMINING A SUFFICIENT REVENUE LEVEL

As noted above, the repayment program is also used to determine a minimum revenue level sufficient to meet a given set of obligations.

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A set of trial revenues can be obtained by multiplying a set of given revenues by a factor. A factor is an assigned real number. If the set of trial revenues obtained with a factor is found to be insufficient, then all lower factors are known to produce insufficient revenues. If some other factor is found to produce sufficient revenues, then all higher factors are known to produce sufficient revenues. Therefore, only intermediate factors need to be tested.

Testing any intermediate factor establishes one of two propositions: (1) that either it and all lower intermediate factors are excluded; or (2) that it and all higher intermediate factors are included. In this manner, the set of intermediate factors is reduced. Through this repeated testing (referred to as the binary search technique), the set of intermediate factors is reduced to a size determined by a preset tolerance limit (the tolerance level of the current study is set at .005 percent of the given revenues).

The lowest factor that is determined to produce sufficient revenues in accordance with this testing procedure will produce the <u>minimum</u> revenue level, within the accuracy of the program, that meets <u>all</u> repayment obligations with interest subject to the conditions specified in RA 6120.2 and relevant legislation.

3. TREATMENT OF BONDS ISSUED TO U.S. TREASURY

BPA's current long-term bonds issued to the U.S. Treasury consist of term bonds and callable bonds. The term bonds cannot be prepaid, so their amortization and the revenues required therefore are excluded from the above calculations. The remaining bonds are callable bonds and have provisions that allow for early redemption before the maturity date--5 years after the date of the issuance on some older bonds and longer periods on some of the more recently issued bonds. In addition, a premium must be paid if a bond is repaid before its due date. The premium that must be paid decreases with the age of the bond. This premium affects the repayment process in two ways.

First, such premiums must be included with the payments of equation 2 and consequently affect the fourth set of equations. The premium that is paid on any Federal bond is considered to be due when the Federal bond is due. The premiums of one iteration are accumulated by due year and included in the fourth set of equations for the following iteration. When each premium is paid in the following iteration, it is used to modify the fourth set of equations and is also accumulated in case another iteration is necessary.

Second, the decrease in the premium that must be paid also affects the highest interest selection process. This effect is equivalent, in total, to a fixed premium and a reduced interest rate. This reduced effective interest rate enters into the comparison with other Federal investments and obligations to determine which should be repaid first.

See Table 22, Application of Amortization.

4. INTEREST INCOME

BPA is authorized by applicable legislation and RA 6120.2 to calculate interest income as a credit to interest expense. An interest income credit is computed within the repayment program based on the average cash balance of funds required to be collected for return to the U.S. Treasury in that year. The program assumes that the cash accumulates at a uniform rate throughout the year, except for interest paid on bonds issued to the U.S. Treasury at mid-year. At the end of the year the cash balance together with the interest credit earned thereon is used for payment of interest expense, amortization of the Federal investment, payment of bond premiums, and payment of Corps and Bureau O&M.

5. FLOW CHARTS

The following pages contain flow charts associated with the repayment study program. The first chart shows the binary search process. The second chart shows the test for sufficiency. The third chart shows the application of revenues. See Chapter 5, Documentation Volume 2 of the Study, WP-96-FS-BPA-02B.

6. DESCRIPTION OF REPAYMENT PROGRAM TABLES

Tables 23 through 27, A through H, show the results from the separate power repayment studies for FYs 1997 through 2001, respectively, using revenues from current rates. Tables 28 and 29 provide the application of amortization through the repayment period for generation and transmission, respectively, based upon the revenues forecast using current rates.

Tables 23 through 78, A through H are identical in format. BPA developed this format in response to FERC's order requiring separate transmission and generation power repayment studies.

Tables 23A-27A display the repayment program results for the generation component of the FCRPS for FYs 1997 through 2001. Column A shows the applicable fiscal year. Column B shows the total investment costs of the generating projects through the cost evaluation period. See Chapters 3 and 5, Documentation Volume 1 of the Study, WP-96-FS-BPA-02A. In Column C, forecasted replacements required to maintain the system are displayed through the repayment period. See Chapter 12, Documentation Volume 1 of the Study, WP-96-FS-BPA-02A. Column D shows the cumulative dollar amount of generation investment placed in service. This is comprised of historical plant-in-service, planned replacements and additions to plant through the cost evaluation period, and replacements from the end of the cost evaluation period to the end of the repayment study period. For these studies all additional plant is assumed to be financed either by appropriations or bonds.

In Column E scheduled amortization payments for generation are displayed for each year of the repayment period. Discretionary amortization (Column F) shows generation related amortization payments made after the "critical year" but before the due dates of each particular project. (The

critical year is defined as the last year of the repayment period during which the optimization of interest and amortization requires that the annual costs, interest, and amortization equal the minimum revenue level; this is made manifest by amortization payments approaching zero or retiring only obligations which could not be prepaid and are due.) Unamortized Federal generation investments or obligations, shown in column G, are determined by subtracting amortization and discretionary amortization from the cumulative amount of Federal generation investments or obligation for each year. Columns H, I, and J show a similar calculation of predetermined amortization payments and the unamortized amount of irrigation assistance for each year of the repayment period. Irrigation assistance is assigned 100 percent to generation.

Tables 23B-27B display the repayment program results for the transmission component of the FCRPS. Columns A through G illustrate the same procedures and data requirements as discussed in Tables 23B-27A, except that Tables 23B-27B encompass only transmission Federal investments or obligations. Historical transmission data are addressed in Documentation Volume 1 of the Study, , WP-96-FS-BPA-02A, Chapter 9. Future transmission investments through the cost evaluation period are documented in Chapter 2. Transmission system replacements are documented in Chapter 12.

Tables 23C-27C display planned principal payments by fiscal year for the Federal investment and obligations of the FCRPS. Shown on these tables are the principal payments associated with the appropriations of BPA, the Corps, and the Bureau, and BPA bonds. These principal payments are segregated between the transmission and generation related Federal investments and obligations of the FCRPS.

Tables 23D-27D show the component of the capitalized contractual obligations associated with payment of principal. Included is the stream of payments associated with a long-term, relatively

fixed, energy resource acquisition contract that will not be capitalized. The capitalized contractual obligations are 100 percent generation related. Tables 23E-27E show the scheduled interest payments for the Federal investment and obligations of the FCRPS in the same manner as the principal payments in Tables 23-28C discussed above. Using the same format as Tables 23D-27D, Tables 23F-27F detail the component of capitalized contractual obligations associated with the payment of interest expense on these bonds.

Tables 23G-27G provide a summary of all principal and interest payments associated with all FCRPS investments and obligations. Columns B, C, and D represent the principal portion of the transmission, conservation and generation, and capitalized contractual obligations. Column E is the total principal payment. Columns F, G, and H represent the interest portion of the transmission, conservation and generation, and capitalized contractual obligations. Column I is the total interest payment.

Tables 23H-27H compare the schedule of unamortized Federal investments and obligations resulting from the power repayment studies to the Federal investment and obligations that are due and must be paid for each year of the repayment period. Columns B and D show unamortized Federal investments and obligations for the generation and transmission components of the FCRPS, respectively. These data are identical to the data shown in Column G of Tables 23A-27A. Columns C and E entitled "Term Schedule" show Federal investments and obligations that are due for each year. It should be noted that unamortized Federal investment and obligations are always less than the term schedule, indicating that the FCRPS planned repayments are in excess of repayment obligations, thereby satisfying repayment requirements. (The total of Unamortized Investment need not be zero at the end of the repayment period because of the replacements occurring subsequent to the cost evaluation period.)

Tables 28 and 29 list by year through the 50-year repayment period the application of the amortization payments, consistent with the revised repayment studies, by project. The projected annual amortization payments on the Federal investments and obligations are identified by the project name, in-service date, due date, and interest rate. The amount of the Federal investment or obligation is shown as both the original gross amount due and the net amount after all prior amortization payments.

APPENDIX A

LETTER FROM THE ADMINISTRATOR
JUNE 3, 1996
ON BPA COST-CUTTING INITIATIVES