

ADMINISTRATOR'S RECORD OF DECISION

BPA Contract No. DE-MS79-84BP90946 relating to  
the initial filling of Revelstoke Reservoir and  
additional uses of storage space in Canada

and

BPA Contract No. DE-MS79-84BP90945, a companion  
agreement with 17 mid-Columbia project  
owners and purchasers

BONNEVILLE POWER ADMINISTRATION

U.S. DEPARTMENT OF ENERGY

JANUARY 1984

## Administrator's Record of Decision

BPA Contract Nos. DE-MS-84BP90945 and DE-MS-84BP90946

Purpose. This document supports the decision by the BPA Administrator to enter into BPA Contract No. DE-MS79-84BP90946 (attached) with B.C. Hydro relating to the initial filling of inactive storage space at Revelstoke reservoir and additional uses of storage space in Canada and a companion agreement, BPA Contract No. DE-MS79-84BP90945 (attached), with 17 mid-Columbia project owners and purchasers.

Summary of Agreements. Contract 90946 with B.C. Hydro is basically a 10-year agreement, running until July 31, 1993; however, it can be terminated by either BPA or B.C. Hydro as early as July 31, 1989, and certain of its provisions may run for a few years beyond the normal termination date under certain conditions. It provides: (1) mutually acceptable methods to accomplish the initial filling of inactive storage space at B.C. Hydro's Revelstoke Project and at certain other relatively small new reservoirs in Canada; (2) for mutually beneficial uses of certain non-Treaty storage space in reservoirs in Canada by both BPA and B.C. Hydro; and (3) for storing water in Treaty space in Mica and Arrow reservoirs in addition to that which is currently permitted under the Columbia River Treaty (Treaty). Contract 90945 with the 17 utilities having an interest in generation at the five non-Federal mid-Columbia projects is a necessary companion agreement.

History. The history of negotiations between BPA and B.C. Hydro is important because the proposed agreement reflects many long-standing positions of both sides. This history extends back to the time Mica initial filling began in April 1973. Storage space in the Mica reservoir consists of three parts: approximately 8 million acre-feet (MAF) of inactive storage needed to provide head for the generating units at Mica; approximately 7 MAF of active storage which is operated pursuant to the Treaty; and approximately 5 MAF of active storage which is not dedicated to Treaty use. A "Program for Initial Filling of Mica Reservoir" was agreed on by the U.S. and Canadian Entities in August 1967. The first year after Mica closed was the drought year 1973, and less than 7 MAF of space filled. Under the terms of the Treaty, this water was treated as active storage. The second year, 1974, was a record high spring runoff. Still, less than all the Treaty active and inactive space was filled. 1975 was a moderate runoff year and again the Treaty active and inactive space did not completely fill. Finally in the high runoff year 1976, the entire 20 MAF filled.

Beginning at that time (1976) BPA believed that BPA and B.C. Hydro could find a mutually beneficial arrangement to use some or all of the 5 MAF of non-Treaty active space. Contacts were made at high management levels at both BPA and B.C. Hydro, and preliminary talks were held. However, there had been no agreement on the use of the 5 MAF prior to its filling, and achieving such an agreement proved to be very difficult.

In 1977 the Columbia River experienced its worst spring runoff of record. In February 1977, BPA and B.C. Hydro, acting as the U.S. and Canadian Entities, agreed on an "Emergency Draft of the Canadian Storage." This agreement

provided for the release of up to 1.69 MAF of water from Canadian reservoirs in addition to the releases to be made pursuant to the Treaty. Initially, this water was to be taken from Treaty space in Arrow and Duncan reservoirs. Ultimately this water was to be provided, if subsequent streamflow conditions made it necessary, from water stored in non-Treaty space in Mica. The energy produced at downstream Federal projects was used to serve BPA's interruptible industrial loads. This arrangement, which was made during a time of very poor power supply in the U.S., was quite favorable to B.C. Hydro. It provided a strong precedent for negotiating future agreements for use of non-Treaty reservoir space in Canada.

In every year from 1977 to the present, BPA and B.C. Hydro have made one or more arrangements for the storage and release of water in Canadian reservoirs on the Columbia River headwaters or for storage of excess generation due to fishery releases in other reservoirs in Canada. Attachment 1 gives a list of those agreements.

An agreement between BPA and B.C. Hydro signed in April 1978 represented a significant use of Treaty space by BPA and a significant release of water from non-Treaty space by B.C. Hydro. BPA sought this agreement because the Mica Treaty water had been drafted in proportion to other reservoirs, including major U.S. reservoirs, during the 1977 drought. Subsequent operation of that reservoir pursuant to the Treaty operating plan was predicted to result in a failure to refill all of the Treaty space in Mica in the summer of 1978. Meanwhile, all other reservoirs in the Pacific Northwest were predicted to refill and the power system was predicted to have surplus energy. In return for the provisions in that agreement which allowed BPA to store in Treaty space in Mica, BPA granted B.C. Hydro the right to release .5 MAF of the 5 MAF of non-Treaty water then stored in Mica and to receive all the energy that could be generated at downstream U.S. plants. B.C. Hydro did release that water under that agreement, and only about 4.5 MAF of water remains in that 5.0 MAF of space.

A similar agreement allowing BPA to store energy in Treaty space in Mica to assist its refill was executed in June 1980. This agreement did not provide for release of non-Treaty storage by B.C. Hydro.

In 1980 and 1981 B.C. Hydro made available 2 feet of space above the level used to store Treaty water in Arrow. Water was stored in the space during high spring flows and released in the fall months. BPA and B.C. Hydro shared the downstream U.S. generation equally. BPA paid one-half of the "water use fee" assessed B.C. Hydro by the B.C. government.

In each of the cases involving re-regulation of water in the Columbia River, companion agreements between BPA and the non-Federal mid-Columbia interests were necessary. Each of these agreements were completed on short notice with much difficulty.

During all of these years from 1977 to the present, BPA has continued to seek a longer-term, more general agreement to provide uses of space in reservoirs on the Columbia River and its tributaries in Canada in addition to the regulation provided by the Treaty.

In 1978 negotiations were quite active. A couple of abortive attempts were made to outline principles of a longer-term, more general agreement. In June 1979 B.C. Hydro produced a paper "Proposed Columbia River Non-Treaty Storage" which became the basis for negotiation of a draft agreement. One of the major issues under discussion in that negotiation was the amount of the 5 MAF of non-Treaty space in Mica which would be available for BPA and B.C. Hydro to use. B.C. Hydro's June 1979 paper proposed about 0.2 MAF for BPA and an essentially unlimited amount for B.C. Hydro. BPA proposed in a March 1980 paper that each party have the use of approximately 0.9 MAF. Technical level negotiators on both sides believed that they were very close to agreement, at least on principles, in the spring of 1980. At that point, B.C. Hydro technical representatives sought approval from legal and upper-level management at B.C. Hydro. The proposal was rejected by B.C. Hydro management! On July 2, 1980, the primary B.C. Hydro technical negotiator informed Larry Dean, BPA's primary technical negotiator, that negotiations on this subject "should be considered suspended."

Negotiations remained suspended until the fall of 1981. By that time, B.C. Hydro was looking forward to the initial filling of at least 3.5 MAF of inactive storage space in the Revelstoke reservoir, due to be closed in 1983. At that time, BPA and B.C. Hydro negotiators were instructed to resume negotiations, and the upper-level management commitments of both parties were confirmed with a November 9, 1981, letter from Earl Gjelde, BPA, and Herb Kennon, Corps of Engineers, to Hugh Goldie, B.C. Hydro. Mr. Goldie indicated B.C. Hydro's agreement by countersigning that letter.

The negotiation of the presently proposed agreement essentially began at that time.

Provisional Drafting of Reservoirs. Provisional drafting of reservoirs means the drafting of water from a reservoir below the level which that reservoir would otherwise be required to maintain. The energy produced by such draft is delivered to a customer from whom the energy can be recovered later if necessary. Later, if subsequent load and/or resource operations make it necessary, the energy is recovered from the customer in place of reservoir draft normally planned for the later period.

From the beginning of Treaty operations of Canadian reservoirs, BPA believed that it would be possible to draft water provisionally from Mica, Arrow, and Duncan below the level which the Treaty operating plan prescribes. This belief was reflected in the first "Agreement on Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage" dated August 4, 1967. Section 22(b)(iii) of that document stated ". . . either entity may draft Canadian Treaty storage below its Operating Rule Curve on a provisional basis to the extent that replacement energy or its equivalent is guaranteed to be available in subsequent periods to assure that the firm load carrying capabilities of the systems of the two entities are maintained."

In the mid 1970's BPA repeatedly represented to its direct service industrial customers that BPA would be able to provide 2.0 billion kWh of provisional energy to serve interruptible (top quartile) industrial load in the fall of years in which reservoirs refilled. This was enough to serve nearly 1,000 average megawatts of such load for almost 3 months. According to BPA, this

2.0 billion kWh consisted of about 1.3 billion kWh from provisional draft of Treaty water from Mica, Arrow, and Duncan and about 0.7 billion kWh from provisional draft of Libby, Hungry Horse, and Dworshak.

As time went by, the Canadian representatives in Treaty matters informed the BPA representatives that they did not consider provisional drafting of reservoirs to be provided for under the Treaty. While they were not adamantly opposed to such operation, they stated that Canada should receive additional benefits if such operations were to be permitted.

The "Agreement on Principles and Procedures" was extensively revised in May 1979. In this document the previous section relating to provisional drafting was replaced with a new paragraph at the end of Section 23b. This paragraph noted that "while an arrangement has not yet been completed for provisional draft of Canadian Storage, procedures are being prepared by the Operating Committee in accordance with the 13 January 1977 agreement among the coordinators to satisfy the following basic accepted principles." Thereafter followed four principles on which the coordinators had agreed. Among other things these principles included: "The arrangement would produce advantages to each country compared to operating to the Assured Operating Plan . . . ." However, such procedures never have been developed.

Settlement of the provisional drafting issue was included in the initial list of issues which the presently proposed agreement was supposed to handle. However, this subject was shunned by the B.C. Hydro negotiators and was not vigorously pursued by the BPA negotiators. As a result, the proposed agreement does not deal in any fashion with the question of provisionally drafting water from Treaty space in reservoirs in Canada.

Except for the 1977 "Emergency Draft of Canadian Storage," there has never been a provisional draft of Canadian reservoirs, and that 1977 arrangement was intentionally labeled an "emergency draft" to distinguish it from a provisional drafting of reservoirs.

Revelstoke. The initial filling of inactive storage at Revelstoke was a factor which has affected negotiations of any long-term agreement for use of storage on the Columbia River in Canada.

Revelstoke is, by any comparison, a very major dam and reservoir. It is located on the Columbia River just a few miles upstream from the town of Revelstoke in British Columbia. It will flood all of the formerly undeveloped river between the upstream end of the Arrow Lakes and Mica. The dam stands over 450 feet high and will impound about 3.5 MAF of inactive storage and 0.8 MAF of storage that B.C. Hydro may release under certain circumstances. Storing of 3.5 MAF in Revelstoke will fill the reservoir to elevation 1850 feet. Filling the remaining 0.8 MAF will bring the reservoir to elevation 1880 feet, the normal full elevation of the reservoir. The dam was originally planned to be closed and to begin filling in April 1983. However, construction problems delayed closure until the fall of 1983. Closure was actually made on October 11, 1983.

Seven Mile. The precedent set (or not set) by the initial filling of B.C. Hydro's Seven Mile project is one of the issues addressed in the proposed BPA-B.C. Hydro agreement.

On November 3, 1979, B.C. Hydro closed its new Seven Mile dam on the Pend Oreille River in Canada. This closure caused the retention of 0.068 MAF of water in the reservoir behind that dam. BPA did not raise an objection to that action until just before it occurred. Because of the precedent which such filling might set, BPA took the position at that time that B.C. Hydro did not have the right to retain this water in Canada permanently without compensating downstream U.S. interests for the energy they lost as a result of B.C. Hydro's action. The fall months of 1979 were extremely dry, streamflows were low, and the return to service of PGE's Trojan thermal plant was delayed from July until December of that year. Portland General Electric Company, the primary user of Trojan generation, was very short of energy and was purchasing very high-cost power from as far away as Texas at the time of the Seven Mile filling.

In the spring of 1980, the Columbia River Treaty Operating Committee, at the suggestion of the B.C. Hydro representatives, agreed to store 0.068 MAF of water that was unusable for power generating purposes into a part of the non-Treaty storage space at Mica which was vacant at the time. It was the stated intention of the Operating Committee that this water would be released the following fall when circumstances were expected to be similar to those which existed in November 1979.

In the summer of 1980, BPA and B.C. Hydro lawyers and managers tried to agree on wording in an exchange of letters which would provide for the release of this water without setting a precedent, but they failed to do so. B.C. Hydro decided that it would not release this water because to make downstream power interests whole for the water stored in Seven Mile would set a precedent for their obligations relative to Revelstoke. That water is in Mica today. It will be released for use by downstream U.S. interests pursuant to section 3(e) of the proposed BPA-B.C. Hydro agreement.

The Corps of Engineers. The North Pacific Division of the Corps of Engineers has a vital interest in any agreement of the type proposed. Their Division Engineer shares the responsibilities of the Columbia River Treaty "U.S. Entity" with the BPA Administrator. The Corps has the responsibility for operating Treaty space (and in some cases non-Treaty space) in reservoirs in Canada in coordination with U.S. reservoirs to provide flood control on the Columbia River. Corps of Engineers representatives have been present and have taken an active part in almost every meeting of BPA and B.C. Hydro negotiators through the many years.

Mid-Columbia Utilities. There are five non-Federal dams on the Columbia River which are affected by any arrangement of the type being discussed. These dams are Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids. They are owned and operated by Douglas County PUD, Chelan County PUD, and Grant County PUD. Shares of the variable output of these dams have been sold on a long-term basis to a number of Pacific Northwest investor-owned utilities and public agencies. Over the term of the proposed agreement there are 14 such purchasers, making a total of 17 utilities with an interest in the mid-Columbia non-Federal generation. These shares range from Puget Sound Power and Light's 34.1 percent to Kittitas County PUD's less than 0.1 percent of the non-Federal mid-Columbia generation. Any agreement, especially any longer-term agreement, affecting the flows of the Columbia River requires the

participation of the mid-Columbia utilities to achieve the full benefit of that agreement. A companion agreement between BPA and each mid-Columbia utility has been executed for each of the agreements listed on Attachment 1 except those involving storage of excess generation due to fishery flows in B.C. Hydro reservoirs which do not affect the Columbia River.

Although BPA and the Corps have not included representatives of these utilities in the negotiations with B.C. Hydro, BPA has attempted to keep representatives of these utilities informed. Meetings specifically for that purpose were held as early as November 2, 1976. Each time negotiations became serious, meetings were held or written material was distributed to the mid-Columbia utilities or their representatives. All 17 affected utilities are well aware of the present status of the negotiations. All except the four presently having service and exchange agreements with BPA executed short-term agreements in June and September of this year which cover some early storing of water which will eventually be retained in Revelstoke.

Negotiation of the Proposed Agreement. Negotiation of the BPA-B.C. Hydro agreement in its present form began after the exchange of the November 9, 1981, letter confirming the intentions of the parties. Good progress was being made toward "a mutually beneficial" arrangement when, in a letter to BPA dated August 10, 1982, B.C. Hydro threatened to "store all local inflow above Revelstoke in the reservoir from the time of closure until the reservoir is full. During this period all requirements for storage releases from Mica will be passed through Revelstoke to the extent possible." Later, B.C. Hydro representatives clarified that their intended meaning of this statement was that they would store into Revelstoke all inflow to the project except the Mica Treaty storage releases, thereby reducing the flow of the Columbia River at the U.S.-Canadian border by the amount of water stored into Revelstoke.

Such storing of water by B.C. Hydro would reduce the firm energy capability of the Pacific Northwest region by more than 4.5 billion kilowatthours. Attachment 2 is a calculation of the amount of energy which would be lost at downstream U.S. plants.

B.C. Hydro's August 10 letter created a good deal of concern within BPA. It was referred to BPA's legal counsel who met with B.C. Hydro's legal counsel to hear their position on this matter and to present BPA's (the United States') legal position to B.C. Hydro lawyers. Clearly the two positions were in major disagreement. No contract negotiating sessions were held during the next few months.

Prior to the annual meeting of the U.S. and Canadian Entities on December 3, 1982, the staffs of BPA and B.C. Hydro tentatively agreed that, although they each adamantly disagreed with the other's legal position, it might be possible to negotiate a mutually acceptable agreement without either side admitting that their position was not correct. At that December 3 meeting, the Entities confirmed their commitment to work on such a "mutually beneficial" agreement. The Canadian Entity placed a June 1983 deadline on reaching such an agreement. If agreement were not reached by that date, the Canadian Entity stated that B.C. Hydro would pursue the method of storing threatened in their August 10, 1982, letter.

The positions of the two sides and the "agreement to disagree" is stated succinctly in the first three paragraphs of Section 3(a) of the proposed BPA-B.C. Hydro agreement.

The negotiators attempted to draft contract language to reflect the progress being made beginning at that time. Both BPA and B.C. Hydro involved their legal counsel from the beginning of this effort.

By March 1983 considerable progress had been made. On March 23, BPA mailed to the 17 mid-Columbia project participants copies of the draft BPA-B.C. Hydro agreement which BPA and B.C. Hydro had developed by that time, a draft of a companion mid-Columbia agreement, and some explanatory material. At a meeting with mid-Columbia participants held on April 11, BPA handed out more explanatory material.

BPA negotiators believed that agreement on an acceptable BPA-B.C. Hydro contract was close to being achieved.

However, there were a number of unresolved major issues identified in that contract draft. The most important of these was an attempt by BPA to assure that some non-Treaty space would be available to BPA during a major part of the term of the agreement. BPA was attempting to do this by placing limits on the times and rates B.C. Hydro could withdraw storage space, once they had made it available. Another major disagreement was whether BPA should compensate B.C. Hydro for head losses at Mica created when BPA withdrew water BPA had stored in Mica. A third issue was the reluctance of BPA to pay a "water use fee" for energy it and other downstream U.S. utilities would generate from water stored in non-Treaty space. This fee would be imposed by the B. C. government. The fee had already been increased several times in past years, and there was a clear indication that it would increase further in the future. Neither BPA nor B.C. Hydro had any control over these increases.

A very significant breakthrough on these issues was made when, at a meeting on April 12, 1983, B.C. Hydro representatives handed out a paper: "Proposal for the Initial Filling of Revelstoke Storage." Attachment 3 is a copy of B.C. Hydro's paper. In this paper, B.C. Hydro proposed to settle all of the above issues in BPA's favor if BPA would accept one-half of the energy losses in the United States from the filling of Revelstoke. BPA would have to fill its one-half of 2.3 MAF within 2 years after the closure of Revelstoke and its one-half of the other 2.0 MAF by the end of the 10-year agreement. In return, B.C. Hydro was willing to make 1.0 MAF of active storage space available in Mica for BPA to use for the 10-year term of the agreement, to waive the requirement that BPA deliver head losses to B.C. Hydro during the term of the agreement, and to waive any obligation of BPA to pay the "water use fees" for using non-Treaty storage space.

BPA's initial reaction to the proposal was negative. Never before had BPA even considered being responsible for any of the energy losses downstream in the U.S. which would result from filling inactive storage space in Canada. However, after consultation with BPA legal counsel and management, BPA agreed to study the proposal. This study indicated that the risks BPA would assume in order to fill one-half of the 2.3 MAF were more than offset by the expected benefits BPA would receive through use of the 1.0 MAF for 10 years. The results of this study are summarized in the Benefits/Costs section of this document.

Based on this study and advice of legal counsel, BPA made a counter-proposal that accepted all of B.C. Hydro's April 12 proposal except for the obligation that BPA have its one-half of the remaining 2.0 MAF full at the end of the agreement. In its study, BPA did not force its 1.0 MAF full at the end of the agreement. It was obvious that to do so would render the 1.0 MAF relatively useless during the last several years of the agreement.

B.C. Hydro, in turn, accepted BPA's counter-proposal, but insisted that BPA give a priority to filling this space over "low-value nonfirm energy sales outside the Pacific Northwest" after the normal end of the agreement and that BPA compensate B.C. Hydro for head losses caused by that vacant space after the normal end of the agreement. BPA agreed to these two conditions.

A new issue arose regarding BPA's obligation to fill Revelstoke space in the event that either party exercised its rights to terminate the agreement before the end of its normal 10 year-term. The agreement can be terminated on several year's notice, but must run a minimum of 5 years. (Six, now that the first notice date has passed.) B.C. Hydro eventually agreed to prorate BPA's obligations to fill inactive space based on the number of years the agreement runs.

Benefits/Costs of the B.C. Hydro Agreement. Execution of this agreement will resolve, at least for the term of the agreement, the legal dispute between BPA and B.C. Hydro regarding the initial filling of reservoirs in Canada. Whether this particular resolution is favorable to BPA cannot be determined without knowing how the dispute otherwise would have been resolved. There is, however, one certain but intangible benefit: BPA will not have to litigate the dispute in an international forum.

The BPA-B.C. Hydro agreement provides for four separate types of storage: (1) storage of water into Treaty space above the level that results from Treaty operation; (2) storage of water in non-Treaty space which B.C. Hydro may make available from time to time; (3) storage of water in the 1.0 MAF which B.C. Hydro is obligated to make available for use by BPA during the term of the agreement; and (4) storage of water into inactive storage space to initially fill new reservoirs in Canada. The agreement allows/obligates both BPA and B.C. Hydro to participate, more or less equally, in each of these types of storage. Of the four types, the last two are the most important from a benefit/cost standpoint. BPA's benefits and costs resulting from the first two are discussed in the next two paragraphs. BPA's benefits and costs from the third and fourth are discussed together thereafter.

Under the agreement, BPA may store water into vacant Treaty space. This is space above the reservoir elevation which results from operating pursuant to the Treaty and below the maximum elevation permitted by flood-control operations (or full if there is no flood-control requirement). In general, BPA does not view this right as one that will produce significant monetary benefits and the additional operating flexibility BPA gains from these provisions has not been evaluated in terms of dollars. There probably will be times, however, such as occurred in the spring of 1978 and again in 1980, when the Pacific Northwest hydro system will have surplus energy and Mica will be expected not to refill if it follows the Treaty operation. Under these circumstances this agreement will allow BPA to balance the refill of Mica with

the other reservoirs in the system. Energy that would otherwise be spilled, or perhaps sold as low-priced nonfirm energy, would be stored in the spring and converted to firm energy during the next drawdown season. BPA might be able to avoid establishing second, third, or fourth year FELCC for itself and all the other utilities in the Coordinated System in this way. If BPA uses this type of storage there will be a per kilowatthour service charge for the energy BPA gets back from B.C. Hydro. Nothing in the agreement obligates BPA to use this type of storage. BPA will have to take these charges into account at the time it decides to store into and request return of energy from this type of storage.

No dollar benefits are claimed for the ability BPA may gain to store in non-Treaty space which B.C. Hydro may make available from time to time under the agreement because there is no assurance that B.C. Hydro will make any such space available during the term of the agreement. However, B.C. Hydro has made such space, in the form of the top two feet at Arrow, available in both 1980 and 1981. If they do make the top two feet available at Arrow and if there is sufficient spring runoff to fill that space with water that is in excess of all markets, release of the water in the following fall would produce about 270 million kilowatthours. Under the agreement one-half would belong to B.C. Hydro, the other half to BPA and other downstream U.S. Utilities. Assuming that BPA could market its portion of this energy at 25.0 mills/kWh, this single operation would yield BPA 2.4 million dollars. In addition, mid-Columbia utilities would gain energy worth 1.0 million dollars at 25.0 mills/kWh. There would be no cost to or fees paid by BPA or the mid-Columbia utilities as a result of this operation since B.C. Hydro agreed to waive the "water use fee" which the B.C. government may impose on the use of this space. Again, there is no assurance that any of this space will ever be made available under this agreement.

The third type of storage (storing into 1.0 MAF of active space) and the fourth type (filling inactive storage space) have been analyzed together. Clearly, it is through use of the 1.0 MAF of active space that BPA stands to gain the most and it is through BPA's obligation to fill its half of 2.3 MAF that BPA has some risk of substantial costs as a result of this agreement. When B.C. Hydro made its proposal to reach an agreement on April 12, 1983, this potential benefit and this potential risk were offered as a package.

At that time, BPA made a study of BPA's potential gains and losses. In this study, we assumed BPA will reserve 200 average MW of its firm surplus energy in the period January-August 1985 for the purpose of meeting its filling obligations under the proposed agreement. We assumed that BPA would have been able to sell this firm surplus only at nonfirm energy rates in the absence of the proposed agreement; and, having reserved the firm surplus for this purpose, the energy not actually used to meet BPA's filling obligation still could be sold at nonfirm energy rates.

This study showed that if the Pacific Northwest experiences streamflow conditions as low as the lowest which occurred in the 40-year period, 1928-1969, BPA could lose as much as \$21.2 million from sales of firm surplus which BPA may have to forego in the period January-August 1985. The study indicates that the risk of this occurring is 2 in 40. There are also four additional chances in 40 that BPA could lose lesser amounts of revenue during this same 1985 period. However, in the other years that this agreement will

be in effect, BPA has no risks of losses and stands to gain revenue from the regulation of the additional 1.0 MAF. The least net revenue gain over the 10-year term of the agreement is \$48.5 million. This gain is net after losses experienced in 1985. Expected (average) revenue gains are \$4.7 million in 1983-84, \$11.4 million in 1984-85 and 1985-86, and between \$14.0 and \$15.4 in the remaining 7 years of the agreement. BPA's expected net revenue gain over the 10-year term of the agreement is about \$132 million. Individual years could have gains as large as \$43.1 million, and the best 10-year streamflow sequence shows a gain of \$188 million.

In addition to BPA's gains, the mid-Columbia project owners and purchasers, who do not share in any of the risks of revenue losses, stand to make gains equal to about 16 percent of BPA's gains, even if they sell the energy they gain at BPA prices. (They usually sell their nonfirm energy at a higher price than does BPA.)

All of the foregoing figures are based on a study made by the Division of Power Supply following B.C. Hydro's proposal in April 1983. The results of this study depend on a number of important assumptions, such as BPA's and the region's firm energy load-resource balances during the term of the proposed agreement, marketability of BPA's nonfirm energy, and the prices at which BPA will sell firm surplus and nonfirm energy. The study results also depend on the strategy BPA will use to fill its half of 2.3 MAF and the strategy it will use to regulate the 1.0 MAF. The reader's attention is directed to a discussion of these assumptions, strategies, and other factors affecting the study which are set forth in Attachment 4.

One important side effect of entering into this agreement is the effect it will have on the amount of energy B.C. Hydro will have available to market. First, the arrangement for initial filling of inactive storage space in the proposed agreement will absorb more of B.C. Hydro's energy supply in the first year or two when compared to the method of filling threatened in B.C. Hydro's August 10, 1982, letter, but less than a filling agreement wherein B.C. Hydro would be responsible for all the energy losses downstream in the U.S. It is impossible to know exactly how this issue would have been resolved in the absence of this agreement, therefore it is impossible to know whether the effect of B.C. Hydro's energy supplies under this agreement is favorable or unfavorable to BPA. What is known is that B.C. Hydro's energy supplies under this agreement are approximately half way between the extremes of the two possible outcomes described above.

The proposed agreement also enables B.C. Hydro to use their 1.0 MAF of active storage space and any additional non-Treaty space they may make available to produce additional energy supplies over the term of the agreement. These additional energy supplies may be marketed in competition with BPA and therefore have a negative effect on BPA, especially if BPA continues to have either firm energy surpluses or substantial amounts of nonfirm energy. However, if the Pacific Northwest's firm energy resources become balanced with or less than firm load during the term of the proposed agreement, B.C. Hydro's extra energy supplies may be helpful.

BPA has made no analysis of the effects the agreement will have on BPA revenues due to changes in B.C. Hydro's power supplies. In fact, BPA probably doesn't know enough to even guess whether this effect will be favorable or unfavorable to BPA.

One last, small benefit deserves to be mentioned. The proposed agreements contain all the mechanics necessary to store and release water under any of the types of contractual arrangements used to store water in Canadian reservoirs during the last 6 years. No additional contracts will be needed with either B.C. Hydro or the mid-Columbia utilities. In the past, BPA has attempted to make these arrangements on very short notice. These arrangements can be very difficult to complete when one must deal with more than a dozen separate mid-Columbia interests, each with their unique issue, and each with their own time-consuming internal approval and signature process. Hopefully, the proposed agreements will end these difficulties.

Benefits/Costs of Mid-Columbia Agreement. The proposed agreement between BPA and the 17 mid-Columbia owners and purchasers must be viewed as being very advantageous to the mid-Columbia interests, since they receive many of the benefits of the B.C. Hydro agreement without sharing any of the risks of that agreement. However, BPA believes that it must offer such an arrangement to the mid-Columbia interests because the execution of the mid-Columbia agreement by each and every one of the 17 mid-Columbia interests is essential to enabling BPA to execute the B.C. Hydro agreement.

BPA does not pass any of the risks it undertakes in the B.C. Hydro agreement along to the mid-Columbia utilities in their agreement. BPA does, however, allow the mid-Columbia utilities to share in the benefits BPA will receive from regulating the 1.0 MAF and any additional non-Treaty space B.C. Hydro may make available.

BPA was able to negotiate away one of the provisions of the agreement to which some of mid-Columbia utilities had objected earlier. This provision would have required the users of energy generated from water stored in additional non-Treaty storage space to pay a "water use fee." This objectionable provision was eliminated as a part of the package in which BPA assumed the risk of filling one-half of 4.3 MAF over the term of the agreement.

Under the proposed mid-Columbia agreement, the mid-Columbia utilities are not obligated to give up one kilowatthour of usable generation as a result of the initial filling of Seven Mile, Revelstoke, or any other reservoir which may be filled during the term of the agreement. Neither are they required to pay one dollar of service fees, water use fees or any other charges. They stand to receive service fees if B.C. Hydro returns energy from water stored in Treaty space. The only provision under which they will pay any dollars under this agreement is one in which they may, at their option, participate in a purchase by BPA of water belonging to B.C. Hydro.

The proposed mid-Columbia agreement can best be described as having two pairs of effects on the mid-Columbia utilities. First, the utilities receive from either B.C. Hydro or BPA every kilowatthour of energy which they could have generated with the water which is permanently stored (and therefore permanently lost to them) into inactive storage space under the proposed B.C. Hydro agreement. In consideration for this, each mid-Columbia utility grants to BPA, and through BPA to B.C. Hydro, a release from any claim it might otherwise make to this water.

Second, each mid-Columbia utility gives B.C. Hydro certain rights to use turbine capacities at mid-Columbia projects to convert water released by B.C. Hydro from its storage space into usable energy. In consideration, BPA allows the mid-Columbia utilities to keep for their own use the energy which can be generated at their plants from the water BPA releases from storage space it uses under the proposed B.C. Hydro agreement.

There is one additional benefit some of the mid-Columbia utilities would have liked to have obtained under the mid-Columbia agreement. They would have liked to have some control over when BPA will store water into its storage space in Canada. BPA has not included provisions in the mid-Columbia agreement which would have given them that control. Including such provisions would have made the agreement more difficult to administer. Furthermore, because the mid-Columbia utilities are not undertaking any of the risks and obligations under the B.C. Hydro agreement, it is BPA's view that the mid-Columbia utilities should not have the control they seek over the storing of water.

In a late drafting change, BPA did give the mid-Columbia utilities a right to draw out water BPA had stored (or energy in lieu of that water) before BPA releases it. This change was made partly because mid-Columbia utilities sought it and partly because it appeared to simplify the already complicated agreement.

Environmental Assessment. BPA has prepared an environmental assessment of the proposed agreements with B.C. Hydro and the mid-Columbia owners and purchasers (attached). This assessment contains a large amount of information on the proposal itself, alternatives to the proposal, and the environmental effects of the proposal and the alternatives. All of the material in that environmental assessment should be considered to be an integral part of this decision document.

Alternatives to the Proposed B.C. Hydro Agreement. As set forth in BPA's environmental assessment, BPA sees two alternatives to the proposed agreement with B.C. Hydro. The first would be not to enter into any agreement with B.C. Hydro (a no-action alternative). If we were to do this, we could anticipate that B.C. Hydro would attempt to fill the storage space in Revelstoke and other new reservoirs in Canada as they threatened to do in their August 10, 1981, letter. If we then took no action, BPA and other downstream U.S. utilities would lose more than 4.5 billion kWh of generation from the filling of Revelstoke alone. BPA might react to the retention of water in Canada by, for example, seeking to stop the filling or seeking compensation for the losses in an international forum, such as the International Joint Commission, a long-standing U.S.-Canadian commission charged with resolving U.S.-Canadian water issues. If BPA took either of these actions, the outcome would be impossible to predict. Each side (B.C. Hydro and BPA) firmly believes that its legal position on this issue is capable of winning.

Certainly, under this alternative, there would be no other uses of non-Treaty storage in Canada by BPA, nor would BPA gain additional rights to store water in Treaty space.

The second alternative would have BPA attempt to negotiate a "filling agreement" with B.C. Hydro. Such an agreement would cover the initial filling

of Revelstoke and perhaps other new reservoirs in Canada. The 1967 agreement for the initial filling of Mica was such an agreement, but it was developed as a part of the Treaty, itself. The ultimate contents of such an agreement for Revelstoke are highly uncertain and speculative. Perhaps BPA could have gained some control over the timing of the removal of the water from the Columbia River. Perhaps B.C. Hydro would have assumed responsibility for all of the energy lost downstream in the U.S. Perhaps some of the other benefits BPA achieves from the proposed agreement, such as the guaranteed availability of 1.0 MAF of non-Treaty storage space in Canada, the occasional use of other non-Treaty storage space, or the ability to store into Treaty storage space could have been brought into such filling agreement. Or perhaps none of these gains would have been achieved. These questions will never be answered unless such a filling agreement is negotiated.

The Agreement from B.C. Hydro's Perspective. B.C. Hydro will achieve a number of important benefits from the proposed agreement. They too will avoid litigating the initial filling dispute in an international forum. Compared to the worst outcome of that litigation for them, they will get BPA to bear half of the energy losses downstream in the U.S. which will result from the initial filling of Revelstoke and two other relatively small reservoirs they may fill during the ten-year term of the proposed agreement. (They will, however, bear all the energy losses at their own projects.)

B.C. Hydro will receive a "release and discharge from all claims" which BPA or any of the 17 mid-Columbia utilities might assert against B.C. Hydro for the water they store pursuant to the proposed agreement in inactive space in Canada. It appears from the attitudes of the B.C. Hydro negotiators that this is a highly desired objective of their entering into the proposed agreement, possibly because they are presently having to disclose the existence of this dispute over filling inactive space in their bond resolutions.

B.C. Hydro will gain the ability to store 1.0 MAF of water in Mica when it is of little or no value to them or downstream in the U.S. and to release that water and obtain all the energy it will produce downstream in the U.S. when that energy is of more value.

The arrangements will be in place which will enable use of additional non-Treaty storage space, should B.C. Hydro, at their discretion, choose to make some of this space available. If these arrangements are used, B.C. Hydro will get one-half of the energy benefits.

The arrangements will be in place which will allow both BPA and B.C. Hydro to store into unused Treaty space. If BPA stores into this space, B.C. Hydro will receive a service charge for energy they return to BPA.

To achieve these gains, B.C. Hydro will allow BPA to use 1.0 MAF of space in Mica for the ten-year term of the agreement. Use of this space by BPA may cause B.C. Hydro to suffer some head loss at Mica. These losses will occur when BPA drafts water it has stored into Mica, and the losses will continue until BPA refills that space. (It is possible, however, for B.C. Hydro to mitigate this loss by storing into BPA's vacant space if they have excess energy and are willing to risk losing it when BPA refills the space.)

B.C. Hydro has undertaken some risk that it will end up paying all of the "water use fees" assessed by the B.C. government for use of additional non-Treaty space (top two feet of Arrow, for example). They are presently attempting to get the B.C. government to waive these fees for uses under this agreement, and they are optimistic about the outcome. If they are not successful, they can also avoid paying these fees simply by not making any such space available under the proposed agreement. If they do this they will, of course, forego the benefits they would achieve by their use of one-half of such space.

In summary, it appears that B.C. Hydro should expect a substantial net benefit from the proposed agreement. BPA believes that the proposed agreement is, indeed, a "mutually beneficial" agreement.

What BPA Failed To Get. The proposed agreement with B.C. Hydro does not achieve all the objectives BPA has ever hoped to achieve in such an agreement. One such objective was an arrangement to draft water from Treaty space on a provisional basis. Additional efforts will be required if BPA wishes to establish its right to make this type of operation under the Treaty in the future.

BPA also failed to obtain access to any of the 5 MAF of water stored into non-Treaty space in Mica in 1976. Much of the negotiations in 1976-80 revolved around how much of this water BPA (and B.C. Hydro) should have a right to release for their own use. In the proposed agreement, all BPA (and B.C. Hydro) get is a right to use vacant space in B.C. Hydro reservoirs. Before water can be released from that space, water must first be stored into it.

Near the end of the negotiations on the proposed agreement, BPA attempted to escape any obligation to leave its half of the 2.0 MAF full at the end of the agreement. BPA took this position partly because BPA is not expected to have a surplus of firm energy in 1993, and to undertake such obligation without a firm surplus would have seriously impaired the usefulness of the 1.0 MAF during the last several years of the agreement. BPA also contended that this space was truly "active" space, and, as such, should not receive the same "release and discharge of claims" treatment as "inactive" space. But most importantly BPA felt that, if the proposed agreement ends in 10 years with the 1.0 MAF full of water belonging to B.C. Hydro, negotiation of a follow-on agreement which would allow BPA similar use of the 1.0 MAF would be very difficult if not impossible. In the end, the desire of the B.C. Hydro negotiators to receive a release and discharge of claims prevailed, and BPA agreed to fill the 1.0 MAF with water belonging to B.C. Hydro at the normal end of the agreement or shortly thereafter.

BPA also fought against the assessment of a storage service charge for the return of energy generated from water stored in Treaty space. BPA was unable to achieve either the elimination of this charge or any substantial reduction of that charge below the level at which B.C. Hydro began the bargaining.

This listing of concessions BPA did not get is not intended to leave the impression that BPA did not obtain concessions on many important points. In addition to the major provisions of the agreement which were cited earlier in this paper, BPA was able to obtain favorable concessions on many minor

provisions. Among these are the inability of B.C. Hydro to purchase BPA water stored in Treaty space, B.C. Hydro's inability to purchase BPA water stored in up to one-half of non-Treaty space, no storage service charge for return of energy from non-Treaty space, and many more.

Conclusion. Several complex factors were taken into consideration when deciding whether to execute this agreement. The agreement offers an opportunity to settle the dispute regarding the initial filling of Revelstoke without international litigation. BPA has about a 15 percent risk that streamflows will be so low between the date the agreement is executed and August 1985 that BPA will have to forego sales of firm surplus energy in order to meet its obligation to fill one-half of 2.3 MAF. The value of such foregone sales could be as great as \$21.2 million. On the other hand, net BPA nonfirm revenues during the ten-year term of the agreement should increase somewhere between \$48.5 million and \$188 million, depending on the streamflow conditions which occur during the term of the agreement, after netting out any losses experienced in 1985.

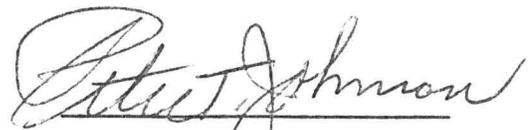
In addition, there are some other potential gains. The mid-Columbia utilities will gain some usable nonfirm energy. BPA may be able to gain some additional revenues if B.C. Hydro makes additional non-Treaty space available, and BPA may be able to gain under some streamflow conditions by storing water in Mica Treaty space.

It appears that the agreement is "mutually beneficial," that is, that B.C. Hydro will also benefit from the provisions of the proposed agreement. Because B.C. Hydro appears anxious to settle the dispute regarding the initial filling of Revelstoke, this is probably the best opportunity BPA will have to make an advantageous arrangement to use non-Treaty storage space in Canada.

BPA has completed an Environmental Assessment and has issued a Finding of No Significant Impact (attached). Both the Environmental Assessment and the Finding of No Significant Impact have received the necessary Department of Energy approval.

Based on the foregoing, I hereby approve the execution of BPA Contract No. DE-MS79-84BP90946 with B.C. Hydro relating to the initial filling of inactive storage space at Revelstoke reservoir and additional uses of storage space in Canada and the companion agreement, BPA Contract No. DE-MS79-84BP90945, with 17 mid-Columbia project owners and purchasers.

Issued at Portland, Oregon, this 13 day of January 1984.



Peter T. Johnson  
Administrator

Additional Uses of Treaty and Non-Treaty Reservoirs  
in the United States and Canada, 1977-1982

<u>Year</u>	<u>Arrangement</u>
1977	Emergency release of Arrow Lakes storage. (Prepared by B.C. Hydro, therefore no BPA contract number. Signed 2/14/77 and 2/18/77.)
1977	Storage of excess generation due to fishery releases in non-Treaty Canadian reservoirs. (BPA Contract No. 14-03-79140)
1977	Delivery of B.C. Hydro energy to BPA to raise the summer level of Arrow Lakes. (BPA Contract No. 14-03-79156)
1978	Storage of energy in Mica to enhance its refill and delivery to Canada of energy from the release of 500,000 acre-feet from Mica. (BPA Contract No. EW-78-Y-83-0069)
1979	Storage of excess generation due to fishery releases in non-Treaty Canadian reservoirs. (BPA Contract No. DE-MS79-79BP90076 and 5-10-79 teletype)
1980	Storage of energy in Mica to enhance its refill. (BPA Contract No. DE-MS79-80BP90138)
1980	Storage of excess generation due to fishery releases in non-Treaty Canadian reservoirs. (BPA Contract No. DE-MS79-79BP90076 and 4-10-80 letter)
1980	Storage of an additional two feet of water in Arrow Lakes. (BPA Contract No. 14-03-90179)
1981	Storage of excess generation due to fishery releases in non-Treaty Canadian reservoirs. (BPA Contract No. DE-MS79-79BP90076 and 4-16-81 letter)
1981	Storage of an additional two feet of water in Arrow Lakes. (BPA Contract No. DE-MS79-81BP90329)
1982	Storage of excess generation due to fishery releases in non-Treaty Canadian reservoirs. (This was under the existing system-to-system storage agreement.)

The above arrangements are in addition to general system-to-system storage and load-factoring agreements which enable BPA and B.C. Hydro to accept energy from the other for storage in non-Treaty reservoir space.

REVELSTOKE PROJECTEnergy Loss at Downstream U.S. Projects

	<u>Inactive Storage</u> Below Elev. 1850 Feet 3.5 MAF (1764.6 ksfd)				<u>Active Storage</u> Elev. 1850-1880 Feet 0.8 MAF (403.3 ksfd)		
	<u>Avg.</u> <u>H/K</u>	<u>Billion</u> <u>KWH 1/</u>	<u>20-Mo.</u> <u>Avg. MW 2/</u>	<u>43-Mo.</u> <u>Avg. MW 3/</u>	<u>Billion</u> <u>KWH 1/</u>	<u>20-Mo.</u> <u>Avg. MW 2/</u>	<u>43 Mo.</u> <u>Avg. MW 3/</u>
Federal	60	2.541	174	81	0.581	40	18
Nonfederal	27	1.143	78	36	0.261	18	9
Total	87	3.684	252	117	0.842	58	27

1/ (H/K) (ksfd) (24 Hr./Day) ÷ 10<sup>9</sup>

2/ KWH ÷ (20 x 730 Hr./Mo. x 1000)

3/ KWH ÷ (43 x 730 Hr./Mo. x 1000)

BPA - Division of Power Supply  
September 8, 1982

(WP-PSP-2431A)

PROPOSAL FOR THE INITIAL FILLING OF REVELSTOKE STORAGE

This package proposal is an attempt to solve the major unresolved issues presently in the draft Columbia River Storage Agreement.

The details are as follows:

1. BPA would share the costs/responsibilities with BCH for the initial filling of Revelstoke storage, which includes the refill of BCH Mica storage used to physically fill Revelstoke storage.
  - a) BPA would be required to fill half of the 2.3 MAF of Revelstoke storage within the first two freshets after Revelstoke closure is complete (by October 1985).
  - b) By the termination date of this agreement BPA would also be required to fill one-half of the remaining 2 MAF of Revelstoke storage declared available by BCH for operation under this agreement.
  - c) BPA would not be required to deliver in-lieu energy to BCH for water stored in Revelstoke storage.
  - d) BCH would make every attempt (reasonable efforts) to adjust Arrow, Revelstoke and Mica storages to maximize ability to accept storage during periods of low H/K while BPA and BCH are attempting to fill Revelstoke storage.
  - e) BCH and BPA shall have equal opportunity to use water that has low value, or is surplus to BPA's requirements to fill the Revelstoke storage.
  - f) BCH and BPA shall be able to transfer storage from their respective Treaty or Non-Treaty Storage Accounts to Revelstoke storage and without payment of any transfer fee.

2. In return for the requirement that BPA share the costs/responsibility for the initial filling of Revelstoke storage, BCH would agree to:
  - a) Declare 2 MAF of Non-Treaty space available for use by BCH and BPA for duration of the agreement. 1.0 MAF would therefore be available for use by BPA.
  - b) Waive the requirement that BPA make head loss energy deliveries to BCH when BPA requests release of water stored in the BPA Non-Treaty Storage space in Mica.
  - c) Waive storage fees to be paid to BCH by BPA for use of the Arrow Non-Treaty Storage space.

System Operations  
8 April 1983

## Evaluation of B.C. Hydro's 4-12-83 Proposal

This attachment describes the analysis made by the Division of Power Supply to quantify the expected effects on BPA revenues if BPA were to accept B.C. Hydro's April 12, 1983, proposal.

The results of the study are summarized in the Record of Decision. This attachment will describe the methods used in the analysis, the assumptions made, and the strategy used in the study to fill one-half of the 2.3 MAF and to regulate the 1.0 MAF to produce additional usable energy.

Only two related parts of that proposal were analyzed: The obligation of BPA to fill one-half of 2.3 million acre-feet (MAF) within the first 2 years of the agreement, and the use by BPA of 1.0 MAF of active non-Treaty storage space in Mica for the 10-year term of the proposed agreement.

No attempt was made to quantify the other aspects of B.C. Hydro's proposal. The expected effects on BPA from these aspects are discussed qualitatively in the Record of Decision.

The part of B.C. Hydro's proposal that would have obligated BPA to leave the 1.0 MAF full at the end of the 10-year term of the agreement was not reflected in this study. Subsequent to April 1983, this part of the proposal was eliminated.

Since the proposal was made, 0.43 MAF of the 2.3 MAF was filled under a short-term agreement, one-half to BPA's credit and the other half to B.C. Hydro's credit. Thus only 1.87 MAF of the 2.3 MAF remains to be filled within the first two years of the agreement. This analysis was revised to reflect the smaller, 1.87 MAF, obligation to fill.

Base Case

Establishing a base case from which the benefits and costs can be measured was an important first step in the analysis. This was a difficult task because the final positions of the parties, if BPA were to reject the proposal, are impossible to know. For the purpose of this analysis, we assumed that no agreement along the lines of the agreement currently being proposed could be achieved and BPA would not achieve any benefits from use of non-Treaty space.

However, we did not feel that it would be realistic to assume that B.C. Hydro would fill the inactive reservoir space in Canada from natural flow at the direct expense of downstream U.S. plants, as they had threatened to do in their August 10, 1982, letter. We have assumed that BPA's legal position on B.C. Hydro's rights to fill inactive storage space is sufficiently strong that we would, as a minimum, seek and prevail in obtaining the international equivalent of an injunction which would keep B. C. Hydro from damaging downstream U.S. interests by reducing flows at the U.S.-Canadian border in order to fill inactive storage space in Canada.

Therefore, we assumed that a third alternative, an initial filling agreement, would be achieved. This agreement would provide that B.C. Hydro could fill inactive storage when and if: (1) BPA and downstream U.S. nonpower interests

determine that they can stand a reduced flow in the Columbia River; and (2) B.C. Hydro delivers to BPA (and BPA to mid-Columbia interests) the energy, if any, that the reduced flows would have produced. Most of this initial filling would probably occur from high spring flows when B.C. Hydro would not be required to deliver any energy to BPA. This arrangement would result in no increase or decrease in BPA's salable energy, nor would it provide B.C. Hydro with any additional energy which it might market in competition with BPA. An initial filling agreement would not allow BPA to store energy or water into either Treaty or non-Treaty storage space in reservoirs in Canada. An initial filling agreement would not allow B.C. Hydro to release the water it had stored in storage space in Canada in order to receive the energy which such water could generate at downstream U.S. plants.

### Study Methods

The requirement that BPA respond in a timely manner to B.C. Hydro's proposal severely limited the type of analysis which we were able to perform. To meet the necessary deadlines, we decided not to make any new hydroregulation studies. Instead, we took an existing 40-year Pacific Northwest regional hydroregulation study and manipulated the resulting total system hydro generation among months to approximate a regulation of the base case and a regulation of the additional storage involved in B.C. Hydro's proposal. Constant water-to-energy factors were used to convert megawatt-months into units of water stored or released. It was actually easier to control the differences between the two studies with megawatt-month adjustments than it would have been with reservoir rule curves and other reservoir operating controls as would have been necessary if a second hydroregulation had been made.

The hydroregulation study we selected was a balanced firm load-resource study using 1985 level resources which had been prepared for BPA's environmental staff to use in evaluating the system-wide power impacts resulting from adopting the Northwest Power Planning Council's Water Budget as a firm constraint. Thus, this hydroregulation already incorporated Water Budget flows. It was a continuous regulation of the 40 water years, 1928-29 through 1967-68. This study is identified as the FF-7B study.

This study is a Pacific Northwest regional study. However, we attempted to evaluate the effect of the proposal on BPA's revenues by discounting the additional generation produced at non-Federal mid-Columbia projects, and by using BPA's IP-2 (industrial) rate and NF-2 (nonfirm energy) rate to value the additional generation. (This study was made before BPA's 1983 rates were finalized.) Although the benefits were discounted for the mid-Columbia generation, the obligation to fill one-half of 1.87 MAF (2.3 MAF less 0.43 MAF) was borne completely by BPA.

Because the region's firm surpluses are changing with time and because BPA's obligation to fill one half of the 1.87 MAF is fixed in time, we decided to do a study of the ten operating years, 1983-84 through 1992-93 which the agreement is expected to cover. Because the expected benefits and costs of B.C. Hydro's proposal depend so greatly on the type of water conditions which may occur over this 10-year period, we ran 40 different 10-year studies, sequencing each of the 40 historical water conditions through each of the ten

operating years. Each of the forty 10-year studies were adjusted to reflect the fact that the region's reservoirs were full on July 31, 1983, and then the reservoirs were regulated continuously through the ten operating years. In those water years which the FF-7B hydroregulation study did not begin with full reservoirs, megawatt-month adjustments were made to nonfirm sales in the first year of the study to reflect the fact that reservoirs were full in the summer of 1983. Table 1 gives the megawatt-month deficiencies which were added to the hydro surplus generation at the beginning of those water years when they coincided with the 1983-84 operating year. These adjustments may have resulted in BPA serving different nonfirm markets in different months than would have occurred if the reservoirs had been regulated starting full on July 31, 1983.

We reflected the significant amounts of firm surplus which the region has in the early part of the 10-year period in the study's load-resource balances and nonfirm energy markets. The amounts of regional firm surpluses are shown on Table 2. These surpluses were based on information supplied by the Division of Power Resources Planning by memo dated May 25, 1983. The surpluses supplied in that memo were adjusted as shown by columns 3 through 8 of Table 2. These adjustments include reduction of the surplus by the amount of combustion turbines and small thermal resources included in the load-resource analysis to account for displacing these resources with firm surplus. WNP 1 and WNP 3 have also been removed to account for delays in their completion. The removal of these resources leaves the region short of resources after June 1988. To balance loads and resources the combustion turbines and small thermal resources used in FF-7B have been added, as needed. When the addition of the combustion turbines and small thermal resources is insufficient to balance loads and resources, unspecified resources are added to bring loads and resources into balance. These unspecified resources are assumed to be a nondisplaceable resource and are not included in the nonfirm energy markets. The region's firm surpluses which are shown in column 9 of Table 2 were treated as uniform monthly firm surpluses.

The surpluses shown in Table 2 have not been reduced to reflect efforts currently underway by BPA and others in the Pacific Northwest to dispose of these firm surpluses. However, if some of these surpluses are disposed of over the Pacific Intertie, the magnitude of the Southwest nonfirm markets would have to be reduced by a corresponding amount, and these two changes would tend to offset each other in this study.

In these studies we assumed that the firm surpluses shown in column 9 of Table 2 are unmarketable as firm surpluses, and that they would be sold to the nonfirm markets and at the prices shown on Table 4. We assumed that BPA would reserve about 200 average MW of this firm surplus during the period January through August 1985 to meet its obligation to fill one-half of 1.87 MAF under the proposed agreement. If BPA were not able to dedicate this amount of firm surplus to its filling obligation, it would have been much more difficult and expensive to accept B.C. Hydro's proposal.

The amounts of nonfirm markets and the estimated value of service in mills per kilowatthour are shown in Tables 3 and 4. Southwest exchange energy obligations and sales to displace thermal resources at the broker rate were not included in tables of available nonfirm markets. We assumed that storage of water into space in Canada was more valuable than selling nonfirm energy at 3 or 4 mills/kWh.

After adjusting for full reservoirs at the beginning of 1983-84 and for regional firm surpluses, the base case was analyzed to determine BPA's expected (40-year average) revenues from service to industrial first quartile and nonfirm markets in each of the 10 operating years.

We then took the unusable generation left from the base case and manipulated it, storing that energy first into the 1.87 MAF of inactive space and then into the 2.0 MAF of active space. One-half of the water stored was credited to BPA, the other half to B.C. Hydro.

In each of the 40 sequences, we examined the amount of water that had been stored in inactive space from unusable generation by August 31, 1985. If that amount was less than the required 1.87 MAF, we backed up to January 1, 1985, and reduced the lowest priced nonfirm sales that had been made in the base case during January 1-April 15 and June 1-August 31 of that year to the extent necessary to fill BPA's one-half of the 1.87 MAF by August 31, 1985.

We released any energy stored in the 2.0 MAF of active space as soon as there was any opportunity to sell nonfirm energy to any of the nonfirm markets shown on Tables 3 and 4 which were unsatisfied in the base case. Half of the energy so released was treated as U.S. energy, and that half was discounted about 16 percent to reflect the non-Federal mid-Columbia generation which will not yield revenue to BPA.

Storage into the 1.87 MAF of inactive space and the first time water was stored into the 2.0 MAF of space was done at 86 kW/cfs. Subsequent storage was at 157 kW/cfs. This technique did not store water as fast as the system actually could when one or more of the eleven downstream U.S. plants were spilling water in excess of turbine capacities. However, inspection of the FF-7B regulation indicated that downstream U.S. plants tended not to have flows in excess of turbine capacities unless there were huge amounts of unused energy, and, in those cases, all the available storage space was filled even without decreasing the conversion factor. This approximation tended to make the 1.87 MAF slightly harder to fill and the 2.0 MAF slightly less usable, so that the final net benefits may be slightly underestimated. Rates of filling were limited by observing minimum outflows of 3,000 cfs at Mica and 5,000 cfs at Arrow in all months, and water budget flows at Priest Rapids from April 16 to May 31.

### Results

The results of the base case and the case using the additional storage as proposed by B.C. Hydro are summarized in Tables 5 and 6. Table 5 indicates that BPA could expect to increase its revenue from nonfirm sales by \$4.7 million, or an increase of about 1.4 percent in those revenues, in operating year 1983-84 if B.C. Hydro's proposal is accepted. This "expectation" is based on an equal probability that any one of the 40 water conditions which occurred in 1928-29 through 1967-68 will occur in operating year 1983-84. As more water is stored into the storage space in successive years, the expected revenue gain increases to about \$11.4 million or about 3.6 percent in operating years 1984-85 and 1985-86, and then levels out at about \$14 to 16 million or about 4.7 to 6.0 percent in the remaining seven years of the agreement. The relatively small changes which occur after 1986-87 reflect the varying amounts of firm energy surpluses which compete with hydro secondary

generation and the variation in displaceable resources available as nonfirm markets.

Too much weight should not be given to the BPA nonfirm revenue estimates for each of the two cases. These figures are very dependent on the many assumptions on which the study was based. However, we feel that the difference between the two cases is reasonably reliable, since the same underlying assumptions were used in both cases.

These studies also identify the maximum risk BPA may incur as a result of accepting the obligation to fill its half of 1.87 MAF by August 31, 1985. Since we waited until January 1, 1985, before we reduced any BPA sales in order to fill the 1.87 MAF by August 31, 1985, BPA suffers no losses in nonfirm revenue until January 1985. Between January 1 and August 31, 1985, the studies show that there are 6 of 40 water conditions under which BPA will actually have less nonfirm revenue if it accepts the B.C. Hydro proposal than it would in the base case. The greatest reductions occur if we experience a recurrence of critical period flows. Under these conditions, the studies show two chances in 40 that BPA's January-August 1985 nonfirm revenues would decrease as much as \$21.2 million. In the other four water conditions, BPA will suffer some lesser amount of revenue reduction as a result of its obligation to fill one-half of 1.87 MAF by August 31, 1985.

The studies also identify water conditions under which BPA's increase in nonfirm revenues can be as much as about \$19 million in operating year 1983-84, and as much as \$36 to \$43 million in the subsequent nine operating years.

The proposed agreement allows BPA and B.C. Hydro 7 years after the normal end of the agreement to fill the last 2.0 MAF. The studies show that, if BPA continues to use water from its 1.0 MAF to generate nonfirm energy until the end of February 1993, it will have its 1.0 MAF of space completely filled on July 31, 1993, in 20 out of the 40 water sequences, between 40 and 90 percent full in 11 out of 40 water sequences, and empty or nearly empty in the remaining 9 out of 40 water sequences.

If BPA does not have its share of the space filled at the end of the agreement, BPA will be obligated to deliver head loss energy to B.C. Hydro. Head losses would amount to about 16 average MW, based on normal reservoir elevations and average discharges at Mica if BPA's entire 1.0 MAF were vacant. The worst historical water sequence requires 5 years to fill the space with otherwise unusable water. No dollar cost has been attributed to the delivery of either this head loss energy or to BPA's obligation to fill any vacant space in its 1.0 MAF after the end of the agreement.

Acceptance of B.C. Hydro's proposal will have the effect of absorbing some of the region's firm surplus or nonfirm energy in the initial filling, thus increasing the marketability and possibly the price of the remaining energy. This increased marketability of nonfirm energy has been reflected in the results of the study.

Table 1

## Adjustments to Initial Reservoir Contents

<u>Water Year</u>	<u>Beginning-of-year Reservoir Deficiencies, Megawatt-months</u>
1928-29	0
29-30	3,411
30-31	9,746
31-32	23,700
32-33	3,906
33-34	0
34-35	3,261
35-36	0
36-37	1,608
37-38	11,832
38-39 and 39-40	0
40-41	2,245
41-42	13,084
42-43 and 43-44	0
44-45	18,130
45-46	10,134
46-47 thru 48-49	0
49-50	2,193
50-51 thru 67-68	0

Table 2  
Regional Firm Energy Surpluses  
Average Megawatts

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Year	Initial Surplus <sup>1/</sup>	Combustion Turbines <sup>1/</sup>	Small Thermal <sup>2/</sup>	WNP <sup>1</sup> <sub>2</sub> <sup>/</sup>	WNP <sup>3</sup> <sub>1</sub> <sup>/</sup>	Comb. Turb. and Small Thermal <sup>3/</sup>	Additional Resources <sup>4/</sup>	= Surplus
1983-84	1259	165	44	0	0	0	0	1050
84-85	1145	165	44	0	0	0	0	936
85-86	1152	165	44	0	0	0	0	943
86-87	1317	165	44	0	467	0	0	641
87-88	1199	165	44	0	811	0	0	179
88-89	905	165	44	0	819	123	0	0
89-90	328	165	44	0	851	391	341	0
90-91	267	165	44	68	874	391	493	0
91-92	833	165	44	813	874	391	672	0
92-93	561	165	44	813	874	391	944	0

<sup>1/</sup> Information supplied by Division of Power Resources Planning - May 25, 1983 memo from G.L. Fuqua to L. A. Dean

<sup>2/</sup> Information supplied by Division of Power Resources Planning - April 1983 telephone conversation between B. A. Hoffman and D. K. Faulkner

<sup>3/</sup> Combustion turbines and small thermal resources necessary to balance loads and resources in the FF-7B study.

<sup>4/</sup> Unspecified additional resources necessary to balance loads and resources in the FF-7B study.

Table 3

Nonfirm Markets Available For Service With  
Northwest Hydro Generation  
Average MW

<u>Type of Market</u>	<u>Operating Years</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>June</u>
DSI Top Quartile	1983-4 to 1992-3	934	934	934	934	934	934	934	934	934	934	934	934
Combustion Turbines	1983-4 to 1987-8	0	0	0	0	0	0	0	0	0	0	0	0
	1988-9	123	123	123	123	123	123	123	123	123	123	123	123
	1989-90 to 1992-3	254	323	328	377	434	438	440	441	385	337	332	328
Small Thermal	1983-4 to 1988-9	0	0	0	0	0	0	0	0	0	0	0	0
	1989-90 to 1992-3	13	23	23	23	29	19	29	29	23	23	23	23
East Group Imports	1983-4 to 1992-3	0	8	106	129	73	50	36	14	5	49	0	0
Weyer.-Longview Fibre	1983-4 to 1992-3	72	84	84	84	84	62	84	84	84	84	84	84
Coal Fired	1983-4 to 1992-3	1074	2001	1879	1916	2258	2258	1142	1142	1066	851	1036	1132
East Group Exports	1983-4 to 1992-3	500	500	500	500	500	500	500	500	500	500	500	500
S.W. Exports	1983-4 to 1992-3	2202	8	8	8	9	25	1511	1818	2226	2226	2226	2213
TOTAL	1983-4 to 1987-8	4782	3535	3511	3571	3858	3829	4207	4492	4815	4644	4780	4863
	1988-9	4905	3658	3634	3694	3981	3952	4330	4615	4938	4767	4903	4986
	1980-90 to 1992-3	5049	3881	3862	3971	4321	4286	4676	4962	5223	5004	5135	5214

Table 4

Assumed Sale Rates Associated With  
Nonfirm Markets

<u>Type of Market</u> <u>(in order of priority)</u>	<u>Effective</u>	<u>Operating Year</u> <u>Avg. MW</u>	<u>Assumed Sale Rate</u> <u>mills/kWh</u>
1. Top Quartile DSI Load	1983-4 to 1992-3	934	26.0
2. N.W. Combustion Turbines	1983-4 to 1987-8	0	-
	1988-9	123	18.2
	1989-90 to 1992-3	368	18.2
3. N.W. Small Thermal	1983-4 to 1988-9	0	-
	1989-90 to 1992-3	23	18.2
4. East Group Imports	1983-4 to 1992-3	39	18.2
5. Weyerhaeuser-Longview Fibre	1983-4 to 1992-3	81	18.2
6. N.W. Coal-Fired	1983-4 to 1992-3	1482	9.0
7. East Group Exports	1983-4 to 1992-3	500	9.0
8. S.W. Exports	1983-4 to 1992-3	1203	9.0
TOTAL	1983-4 to 1987-8	4239	
	1988-9	4362	
	1989-90 to 1992-3	4630	

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Table 5

## Comparison of Expected BPA Nonfirm Revenues

Operating Year	Expected (40-year average) BPA Revenue			
	Base Case \$1000	B.C. Hydro Proposal \$1000	Increase w/B.C. Hydro Proposal \$1000	percent
1983-84	339,827	344,494	4,667	1.4
84-85	319,581	331,006	11,425	3.6
85-86	319,963	331,449	11,486	3.6
86-87	298,113	312,160	14,047	4.7
87-88	262,083	277,297	15,214	5.8
88-89	256,217	271,567	15,350	6.0
89-90	274,496	289,556	15,060	5.5
90-91	274,496	289,460	14,964	5.5
91-92	274,496	289,460	14,964	5.5
92-93	279,496	289,460	14,964	5.5
Ten-year average	289,377	302,591	13,214	4.6