REPORT OF THE INTERNATIONAL JOINT COMMISSION UNITED STATES AND CANADA ON PRINCIPLES FOR DETERMINING AND APPORTIONING BENEFITS FROM COOPERATIVE USE OF STORAGE OF WATERS AND ELECTRICAL INTER-CONNECTION WITHIN THE COLUMBIA RIVER SYSTEM

In identical letters to the United States and Canadian Sections of the International Joint Commission, dated January 28, 1959 and January 29, 1959, respectively, the Secretary of State for the United States and the Secretary of State for External Affairs for Canada referred to the general objectives of the Columbia River Reference of March 9, 1944 and requested a special report as follows:

"The Governments of the United States and Canada, as a part of their continuing discussions, have agreed to request the International Joint Commission to report specially to the Governments at an early date its recommendations concerning the principles to be applied in determining:

"(a) the benefits which will result from the cooperative use of storage of waters and electrical interconnection within the Columbia River System; and

"(b) the apportionment between the two countries of such benefits more particularly in regard to electrical generation and flood control."

In the preparation of this special report, the Commission utilized as background data all the information available to it on the water resources development needs and possibilities in the Columbia River area. This included the reports of the International Columbia River Engineering Board under the Columbia

River Reference, as well as studies of other agencies in both the United States and Canada. A special work group was established to prepare summaries of the available data that would provide a background and orientation and thus facilitate mutual understanding of the situation and conditions under which principles for benefit determination and apportionment would be applied. Also, the Commission approached the problem of formulating principles within the context and intent of the Boundary Waters Treaty of 1909.

The studies of the International Columbia River Engineering Board, as well as other available information, indicate clearly that there are possibilities for cooperative development in the Columbia Basin that could be of mutual advantage to the two countries. Accordingly, the Commission was able to approach the problem of formulating principles for benefit determination and apportionment with information on specific projects for cooperative development which would offer advantages to both countries. The Commission was guided by the basic concept that the principles recommended herein should result in an equitable sharing of the benefits attributable to their cooperative undertakings and that these should result in an advantage to each country as compared with alternatives available to that country. The Commission gave consideration to the practical problems that will be encountered in applying the principles to cooperative

arrangements between the two countries on specific projects in the Columbia River Basin. This was done to ensure that the principles would be workable but no attempt was made to spell out in the principles the detailed procedures that will necessarily be delineated when cooperative arrangements are entered into. The Commission recognizes that several administrative and legislative actions in each country may be necessary before these details can be worked out.

The principal benefits in the downstream country from cooperative use of storage of waters within the Columbia River System are improvements in hydro-electric power production and prevention of flood damage. Although other benefits would also be realized from such cooperative use, the outlook at this time is that their value would be so small in comparison to the power and flood control values that formulation of principles for their determination and apportionment would not be warranted. This is not intended to preclude consideration by the two Governments of any benefits, tangible or intangible, which may prove to be significant in the selection of projects or formulation of agreements thereon.

The prospective downstream power benefits are transportable and within reasonable transmission distances of the boundary. With adequate electrical inter-connection, it would therefore be feasible to share these benefits in kind, that is, share the

power itself rather than its value in money. The flood control benefits, however, accrue in specific localities and are not transportable. Cooperative use of storage designed to produce such benefits therefore requires recompense in money or by other means. In addition to providing a means for the return to the upstream country of its share of downstream power benefits, electrical interconnection between the power systems in the upstream and downstream countries opens the possibility of significant economies and advantages in the operation of the interconnected systems in both countries through the cooperative use of generation and transmission facilities.

In view of the foregoing, the Commission's recommendations on principles for benefit determination and apportionment are presented herein in three sections, namely, general principles, power principles and flood control principles.

GENERAL PRINCIPLES

Selection of Projects

A necessary step in the development of cooperative arrangements involving sharing of downstream benefits is the selection of the projects to which such arrangements would apply.

In selecting individual projects from among the available alternatives in both countries for comprehensive development of the Columbia River Basin, it would be consistent with customary practice to give first consideration to those projects that are

most attractive economically as reflected in the ratio of benefits to costs. It is suggested that this widely accepted principle be followed in international cooperative development of the Columbia River Basin to the extent that it may prove practicable and feasible to do so. If projects are developed successively to meet the growing needs for power production and to provide flood protection, the most efficient projects for those purposes should generally be developed first in order to maximize the net benefits to each country. It is recognized, however, that the results to be obtained from possible cooperative projects in the Columbia River Basin will constitute only a part of the total requirements for water resource development and use in the affected regions in both countries. Therefore application of the principle will necessarily be subject to the sovereign responsibilities in each country with respect to many vital and important national interests which must be taken into account in utilizing the water resources in each country. The Commission therefore recommends the following general principles:

General Principles No. 1

Cooperative development of the water resources of the Columbia River Basin, designed to provide optimum benefits to each country, requires that the storage facilities and downstream power production facilities proposed by the respective countries will, to the extent it is practicable and feasible to do so, be added in the order of the most favorable benefit-cost ratio, with due consideration of factors not reflected in the ratio.

Discussion of General Principle No. 1

It is intended in the application of this principle that benefits and costs of the projects given consideration in either country would be determined on the basis of the same or comparable evaluation standards, including such factors as the nature and extent of the benefits to be considered, the evaluation of such benefits, the determination of the initial investment and the computation of the annual costs.

The phrase "to the extent that it is practicable and feasible to do so" is included in recognition of the fact that it will not always be possible to adopt a project wholly on the basis of its benefit-cost ratio as compared to other projects in the river basin. There may be important non-monetary factors, not reflected in the benefit-cost ratio, which may require consideration and which may be of compelling influence in choosing projects for construction. Such factors include the disruption of community and regional economies, scenic, historic or aesthetic considerations, the preservation of fish and wildlife, and similar considerations, which cannot be adequately evaluated in monetary terms. Other practical considerations that might preclude the theoretically desirable order of construction of projects would include the following:

(a) the availability of funds, whether from public or private sources, may be an important consideration in the scheduling of projects within each country in an extensive basin-wide plan. This factor alone may require selection of a small project providing urgently needed benefits even though the small project

may have a lower benefit-cost ratio than a larger project requiring more funds than are available. On the other hand, it is important to recognize that a small project undertaken for such an immediate consideration might jeopardize an eventual development of far-reaching beneficial consequences.

(b) an urgent need to provide for such purposes as local or regional flood control, navigation, irrigation, or exceptional increases in power requirements may determine the order of project construction rather than the ratio of benefits to costs.

(c) the attitude of affected interests on the flooding of lands and improvements or to the effect of a project on other uses of the water resource may require postponement or abandonment of construction of projects that are the most attractive when viewed solely from the standpoint of their benefit-cost ratio.

General Principle No. 2

Cooperative development of the water resources of the Columbia River basin should result in advantages in power supply, flood control, or other benefits, or savings in costs to each country as compared with alternatives available to that country.

Discussion of General Principle No. 2

This principle was used as a basic concept by the Commission in the preparation of the more specific principles recommended herein, and is recorded for future guidance in the application of those principles.

Trans-Boundary Projects

Projects which could produce downstream benefits to be shared between the two countries may be located entirely in the upstream country, or may be trans-boundary projects in which the benefit-producing potentials of storage and head are partly in each country. Such projects affect the level of water above the boundary and in consequence are subject to Article IV of the Boundary Waters Treaty of 1909. The principles presented elsewhere in this report are applicable directly to storage projects situated entirely in the upstream country and relate to the effects produced in the other. To apply these principles to a trans-boundary project, it is first necessary to assign to each country an "entitlement" to the storage. This entitlement or share of the benefit-producing potential of the storage would then form the basis for determination and apportionment of downstream benefits between the two countries in accordance with the principles recommended herein. In addition, an entitlement to at-site power generation should be determined based on the benefit-producing potential of the head and flow involved. Also, the respective entitlements to share in any other benefit-producing potentials should be determined if significant.

As a basis for determining the "entitlement" of each country to the benefit-producing potentials of storage and head at trans-boundary projects, the Commission recommends the following general principle:

General Principle No. 3

With respect to trans-boundary projects in the Columbia Basin, which are subject to the provisions of Article IV of the Boundary Waters Treaty of 1909, the entitlement of each country to participate in the development and to share in the downstream benefits resulting from storage, and in power generated at site, should be determined by crediting to each country such portion of the storage capacity and head potential of the project as may be mutually agreed.

Discussion of General Principle No. 3

The "entitlements" determined in accordance with this principle provide a basis for establishing benefit credits. The principle is designed to provide flexibility in the arrangements between the two countries for cooperation on trans-boundary projects. The entitlement of a country computed in accordance with this principle would be the basis for determing the share of downstream benefits due that country in accordance with the other principles presented in this report for projects wholly in one country.

POWER PRINCIPLES

The setting in which principles for determining and sharing power benefits from the cooperative use of upstream storage in the Columbia River system would be applied is one in which significant changes are likely to occur within the life of projects that might be considered for development at this time. At present the power loads in the United States portion of the Columbia Basin and adjacent areas of the Pacific Northwest are supplied almost

entirely from hydro-electric plants. The downstream generating plants in the United States are now in a position to benefit materially from storage regulation upstream primarily through improvement of the dependable capacity and useable energy of the downstream plants. As the more economically attractive hydro plants are developed progressively, it will become necessary and advantageous to add thermal plants to the system until ultimately the Pacific Northwest power system in the United States will become predominantly thermal.

In the course of this change, the character of the benefits to downstream hydro-electric plants in the United States from storage will change to benefits in the form of peaking capacity and thermal replacement energy and may change in value.

In Canada, the hydro-electric power potential has not yet been developed to a comparable extent. For this reason, the type of change envisioned in the United States is unlikely to occur in the Canadian portion of the Columbia River Basin and adjoining areas until a considerable period of time has elapsed.

In the light of the foregoing, the Commission has found it necessary in its formulation of principles for determination and sharing of power benefits to allow for changing conditions during the specified period that a cooperative development agreement or any extension thereof would be effective. The principles recommended below for the determination and apportion-

ment of power benefits are believed to be sufficiently flexible to provide for equitable arrangements to permit taking into due account the changing conditions expected.

Application of the power principles to conditions in the Columbia basin would require electrical interconnection between the power systems of the two countries to make possible delivery of the upstream country's share of the power produced in the downstream country from the use of stored waters. Although such delivery could be accomplished initially with a somewhat limited degree of interconnection, the Commission is of the opinion that provision should be made for the eventual development of a broader, long-range plan for cooperative operation of the interconnected power systems of the two countries. Accordingly, the power principles include in addition to those governing cooperative use of stored waters, a principle providing for interconnection and coordination of the major power systems in the Columbia basin and adjoining areas in both countries so as to permit the power utilities of the two countries to gain the advantages of cooperative arrangements in power system operations.

Power Principle No. 1

Downstream power benefits in one country should be determined on the basis of an assured plan of operation of the storage in the other country.

Discussion of Power Principle No. 1

This principle is basic to a determination of the dependable capacity and usable energy that can properly be credited to

operation of upstream storage for the benefit of hydro-electric power generation downstream. Emphasis is placed particularly on the concept of an assured plan of operation of the storage with the expectation that the downstream system will be developed and operated so as to make optimum use of the stream flow regulation provided.

It is a generally accepted engineering principle in the electric power field that any power supply which is classified as "firm" or "dependable" must be deliverable on such a schedule or plan as to assure availability of the power at the times when it is needed to serve the load, particularly during peak load periods. It is, therefore, highly important that river-flow regulation be provided under an agreed operating plan or rule curve that will assure the dispatch of water by the owner of storage facilities to the owners of downstream hydro plants in such a manner as to meet the needs of the latter for delivery of firm power to their customers. Such a plan of operation will provide the maximum downstream power benefit consistent with the degree of coordination agreed upon.

It is expected that a general plan of operation of the upstream storage project will be estimated for the entire period of the agreement with the understanding that mutually satisfactory adjustments in the long-range plan of operation can be made from time to time as necessary. This general provision for

adjustment is additional to the flexibility for changes by either country which may be specifically provided for in the agreement. Factors that may bring about the need for adjustments in the operating plan are covered in the discussion of Power Principle No. 2.

Power Principle No. 2

The power benefits attributable to an upstream storage project should be estimated in advance to the extent possible to the mutual satisfaction of the upstream and downstream countries. These estimates of power benefits should be subject to review in accordance with the agreed principles every five years, or more often as may be agreed, to take into account in subsequent estimates any change in previously assumed conditions and to insure optimum utilization of the storage and accurate determination of future benefits.

Discussion of Power Principle No. 2

This principle is intended to provide in advance of construction of upstream storage reservoirs a long-range estimate of the expected benefits of the international cooperative undertaking. The estimate of benefits, expressed in power, or in monetary terms if necessary, would be determined on the basis of the current assured plan of operation as described under Power Principle No. 1 and in accordance with Power Principle No. 3.

It is contemplated that the appropriate agencies in each country will collaborate in the preparation of the estimate and that it will cover the entire period of the international agreement. Any extension of the agreement would also require similar estimates. It should be based on the relevant conditions of load

and power supply expected to prevail during the period of the agreement. The assumed power supply should include the projects, both hydro-electric and steam-electric, considered most likely to be constructed to meet the long-range needs of the power systems concerned.

In estimating the long range power benefits attributable to upstream storage and in the periodic reviews provided for in this principle, due recognition should be given to the adjustments in storage operation that are likely to be required to meet power loads and other water use needs in either country. Factors in either country which could change and thus alter the role of storage include: the magnitude and characteristics of the power loads to be served, installed generating capacity available in the hydro-electric plants on the affected systems, the amount of thermal generating capacity available and the requirements of other water uses. The time and effect of such changes should be anticipated by the appropriate Canadian and United States agencies as far in advance as possible and taken into account either by provision in the assured plan of operation or by agreement on mutually satisfactory adjustment as a result of the periodic review of the plan of operation and long-range estimate as provided for in this principle.

In addition to the primary purpose of furnishing a long-range estimate of the benefits of the international cooperative undertaking the advance estimate and periodic reviews are expected

to serve several other purposes. The agencies affected will be afforded a basis for anticipating the probable long-range use or role of the storage in the respective countries so that other developments on the affected power systems can be planned well in advance and timely provision made for their construction as required by each country. Assurance as to use of the storage would facilitate advance planning of the transmission systems required to coordinate the storage operation with generating plants on the interconnected power systems. Information provided from the estimates would also aid the two countries in determining the timing and value of other projects of international scope in which they may be jointly interested.

Power Principle No. 3

The amount of power benefits considered to result in the downstream country from regulation of flow by storage in the upstream country should be determined in advance by computing the difference between the amount of power that would be produced at the downstream plants with the storage regulation and the amount that would be produced without such regulation. This determination would be made on the assumption that upstream storage is added at an agreed-upon level or condition of storage and power supply. The storage credit position of the upstream storage thus established should be preserved throughout the period of the agreement.

Discussion of Power Principle No. 3

Application of the with and without principle involves several significant determinations and procedures to insure that the upstream storage receives proper credit for its contribution toward meeting the load. Because of the fact that

successive units of storage capacity added to a system of projects result in decreasing amounts of regulatory effect per unit, the time at which a project is considered as added to the system in relation to the time at which other storages are added affects the amount of regulatory effect and accompanying firm power benefit with which a particular storage project may be credited. Thus the conditions under which a project is considered as added determines its "credit position".

Under this principle, it is intended that the storage credit position of an upstream storage reservoir be determined on the assumption that it is added at an agreed-upon level or condition of storage and power supply. This "level" or "condition" might be defined by relating it to a "base system". The "base system" would be comprised of all developments existing at the time of negotiation of an agreement together with developments actually under construction at that time.

Since many estimates and computations have already been made on the basis of data available during the Commission's consideration of these principles, it is suggested that negotiations undertaken in the near future utilize as a base system the developments existing and under construction on January 29, 1959, the date of the two Governments' request for this report. The pertinent storage developments in the current base system are:

Project	Useable storage
Kootenay Lake	673,000 acre-feet
Hungry Horse	2,982,000
Flathead Lake	1,217,000
Albeni Falls	1,153,000
Coeur d'Alene Lake	225,000
Grand Coulee	5,072,000
Chelan	676,000
Brownlee	1,034,000
	13,032,000 acre-feet

If negotiations are undertaken or continued at a time when major changes have occurred, a revised base system should be agreed upon. Conditions of International Joint Commission Orders of Approval affecting any of these developments would continue to be applicable.

It is contemplated that the representatives of the two governments who negotiate arrangements under these principles would agree on the order in which the storages they have under consideration would be considered as added to the base system so that a credit position for each such storage could be established. It is intended under this principle to provide that the credit positions of the storages thus established will not be adversely affected by the addition of subsequent storage and that the storage credit of such agreed upon storages may increase or decrease only as the role of storage generally in the system changes.

Power Principle No. 4

The amount of power benefits determined to result in the downstream country from regulation of flow by storage in the upstream country would normally be expressed as the increase in

dependable bydroelectric capacity in kilowatts under an agreed upon critical stream flow condition, and the increase in average annual useable hydroelectric energy output in kilowatt-hours on the basis of an agreed upon period of stream flow record. Since this procedure requires relating the increased power production to the loads to be met in the downstream country and adjustment of the upstream country's entitlement to conform more nearly to its load requirements, consideration might be given in the negotiations to the adoption of arrangements that would be less dependent upon consideration of the load patterns in each country.

Discussion of Power Principle No. 4

In determining the increase in dependable hydro capacity and in useable energy output at downstream plants resulting from upstream regulation, the estimates should be based on the ability of those plants, enlarged as necessary, to serve the coordinated system loads in the downstream country expected to be realized during the periods under consideration.

The critical flow period used to determine hydro plant outputs available for supporting dependable capacity on the downstream load would be that corresponding with the agreed-upon level or condition of storage and power supply as contemplated in Power Principle No. 3.

Estimates of increase in average annual useable energy output at the affected downstream plants should be based on an agreed upon period of stream flow record which is expected to give results representative of long term conditions.

It is expected that both dependable capacity and energy benefits will result during the early and intermediate stages of the storage operation, but during the later stages the power benefit may consist only of increased useable energy.

Whether the objectives are to produce the maximum firm power, peaking capacity or thermal replacement energy, the power useable on the downstream load is the basis for determining the monetary value of the power resulting from the co-operative arrangements. Such value as defined later in Power Principal No. 5 would serve as the basis for adjusting the upstream country's entitlement as between capacity and energy, to amounts of equivalent total value, which conform more nearly to the requirements of the upstream country's load.

Power Principal No. 5

Whenever it is necessary to place a monetary value on downstream power benefits arising in one country from storage operation in the other country, the value should be the estimated cost to the downstream country of obtaining equivalent power from the most economical alternative source available except where the appropriate Canadian and United States agencies specifically agree on some other basis of evaluation.

Discussion of Power Principal No. 5

This principal is intended to provide a basis for the evaluation, in monetary terms, of downstream capacity and energy benefits attributable to upstream storages for whatever purposes such monetary evaluation may be required; but is intended to have application only in those cases where appropriate monetary values for specific purposes are not otherwise agreed upon by the appropriate United States and Canadian agencies. It is further intended that where such monetary values are agreed upon by the agencies, for any period during the life of the covering agreement, the value so agreed upon shall over-ride the provisions of this principle.

The alternative source used as a basis for the evaluation should be the most likely source available to furnish an amount of power equivalent to the power being evaluated and might be hydroelectric, thermal or some combination thereof.

Power Principle No. 6

The power benefits determined to result in the downstream country from regulation of flow by storage in the upstream country should be shared on a basis such that the benefit, in power, to each country will be substantially equal, provided that such sharing would result in an advantage to each country as compared with alternatives available to that country, as contemplated in General Principal No. 2. Each country should assume responsibility for providing that part of the facilities needed for the cooperative development that is located within its own territory. Where such sharing would not result in an advantage to each country as contemplated in General Principle No. 2, there should be negotiated and agreed upon such other division of benefits or other adjustments as would be equitable to both countries and would make the cooperative development feasible.

Discussion of Power Principal No. 6

It is assumed that each country would bear all capital and operating costs for facilities it would provide in its own territory to carry out the cooperative development. The upstream country's share of the power would be transmitted to the boundary by the downstream country at such points as may be most economical to the downstream country. Other points could be selected upon request of the upstream country provided that any excess costs to the downstream country are paid by the upstream country. Losses in transmission of the power to the international boundary from the points of generation would be borne by the upstream country.

The voltage at which power would be delivered to the upstream country would be mutually agreed upon but such voltage should be a level that is in common use on the downstream power system through which the transfers of power are to be made.

The load factor at which the upstream country's share of power is delivered should also be agreed upon in advance. Basically, the downstream country should not be required to provide more facilities for generation and transmission to furnish the upstream country its entitlement of power than would be required if the power were to be used in the downstream country at the load factor generally applicable to its affected hydro plants.

Power Principle No. 7

In addition to benefits from cooperative use of stored water, interconnection and coordination of the electric power systems to the extent that they are practicable and desirable, would also provide many mutual benefits which should be shared. Coordination being a continuing function would require specific arrangements on the part of the operating agencies as the need arises.

Discussion of Power Principle No. 7

The first six power principles recommended in this report are directed to determination and apportionment of benefits which would result from international cooperation in the use of stored waters. These are basically hydraulic benefits which can be realized by storing flood flows during the spring and summer months and releasing the stored waters during the fall and

winter months when they can be put to use for the production of firm power at the storage site and downstream. Electrical interconnection between the power systems of the two countries would be required to make possible delivery of the upstream country's share of the power produced in the downstream country from the use of stored waters, but the interconnection capacity provided for this purpose would be only that needed to accomplish such delivery. This limited degree of interconnection would not, however, make possible the greater benefits that would accrue to the two countries from a comprehensive plan of interconnection and coordination.

Such coordination should be recognized in the development of the agreed upon plan of upstream storage operation and in the computation of system power benefits. Separate arrangements may be required for sharing coordination benefits because the electrical coordination envisaged could extend geographically beyond the service areas of the generating plants or power systems directly benefitted by the release of stored waters from storage projects constructed by the upstream country. It is recognized that the power systems in British Columbia are not now developed to the same extent as in the United States portion of the Columbia River basin, but it is the intention of this principle to provide for long-range international cooperation between the systems of the two countries as they continue to develop in the future.

Under arrangements for coordination, it would be expected that all participating power systems would retain their local autonomy but would necessarily operate their generation and transmission facilities under the terms of appropriate agreements with a view to maximizing mutual benefits. The arrangements should set forth the broad operating principles to be observed and should be writtin in sufficient detail to describe the specific purposes and objectives.

FLOOD CONTROL PRINCIPLES

Among the sections in the United States to which principles for flood control benefit determination and sharing would be applicable are the Kootenai River downstream from Bonners Ferry, Idaho, and the lower main stem of the Columbia River. These areas now have partial protection against flooding and there are plans for utilization of storage in the United States to be developed primarily for power purposes in such a way that ultimately a high degree of protection against major floods would be obtained. As successive blocks of storage for flood control purposes are added to the system, the amount of flood damage that can be prevented per unit of flood control storage decreases. Accordingly, the value that can be assigned to upstream storage for flood control purposes is greater for projects to be constructed in the near future than for those to be built later. Also, in the Columbia Basin the hydrologic and

hydraulic characteristics are such that storage can be operated in the interests of flood control to a considerable extent with little, if any, interference with the operation of the same storage project in the interests of power generation.

These factors, as well as other information available to the Commission, have been taken into account in formulating the following principles for determination and sharing of flood control benefits which may result from cooperative development of storage in the Columbia River Basin.

Flood Control Principle No. 1

Flood control benefits should be determined on the basis of an assured plan of operation and flood control regulations agreed to in advance.

Discussion of Flood Control Principle No. 1

The assured plan of operation for flood control would not be a separate plan of operation but rather a joint or composite plan of operation of a given storage project in the interests of flood control as well as for other purposes, principally power. The plan of operation for any reservoir included in the flood control plan, therefore, should be worked out initially so as to obtain the best combination of benefits for all purposes. In the Pacific Northwest meteorological and hydrological conditions and the requirements for storage operations in the interests of power and flood control are such that little, if any, loss of ability to maximize power benefits is required to accommodate flood control

In any event, the plan of operation worked out in accordance with these principles would be the basis for determination of the flood control and power benefits to be shared.

Once the plan of operation is agreed to, normal operations for both power and flood control would be in accordance with that plan. It is to be expected that both the upstream storage interests and the downstream power and flood control interests may wish from time to time to request or suggest deviations from the plan. If such deviations would involve an adverse effect on the other party at interest it would be expected that a basis for compensating for the adverse effect would also be proposed. Such deviations would then be made possible if the deviations and any required compensation were mutually acceptable to both parties. If the upstream country wished to have the option of using alternative storage to provide equivalent downstream flood control effects as contemplated in the plan of operation, such option should be provided for in the agreement.

It is assumed that acts of God, emergencies, and other events over which neither party has control, would be interpreted and handled in the manner usually contemplated in a "force majeure" clause in an agreement.

Flood Control Principle No. 2

The downstream flood control benefit of the upstream storage to be operated in accordance with an agreed-upon flood control plan should be estimated in advance on the basis of the effectiveness of such storage in meeting the flood control objectives applicable in the downstream country at the time the upstream storage is provided.

Discussion of Flood Control Principle No. 2

This principle places prospective Canadian storage to be operated in accordance with an agreed-upon flood control plan in exactly the same position that any concurrently prospective United States storage for flood control purposes would have. The effectiveness of all flood control storage is measured in terms of the flood control objectives applicable at the time the storage is to be provided and the effectiveness determined at that time is applicable for the entire life of the project in question or for the period of agreement in the case of Canadian storage.

In the United States the current primary flood control objective is to obtain storage sufficient to control a flood of the magnitude of that of 1894 at The Dalles to 800,000 cfs. All additional storage in the United States or Canada necessary to achieve this objective (approximately 7½ million acre feet of storage usable for flood control) would, if included in the flood control plan, be given equal credit on the basis of the effectiveness of each acre foot of such storage in controlling floods at The Dalles. Storage either in the United States or Canada added after the necessary amount has been reached to control the 1894 flood to 800,000 cfs would, if included in the flood control plan, be evaluated at a lesser rate based on the average value of all additional storage needed to control the 1894 flood at The Dalles to 600,000 cfs.

Local flood control objectives have also been identified in other parts of the basin especially on the Kootenai River downstream from Bonners Ferry where control of the 1894 flood to a maximum of 60,000 cfs is desirable. Storage either in the United States or Canada should be entitled to credit on the basis of satisfying such local objectives.

Flood Control Principle No. 3

The monetary value of the flood control benefit to be assigned to the upstream storage should be the estimated average annual value of the flood damage prevented by such storage.

Discussion of Flood Control Principle No. 3

The average annual value of flood damage prevented by upstream storage can be computed by conventional methods using stage-frequency and damage-frequency relationships. The methods are described and their application illustrated in the most recent report of the Corps of Engineers on the Columbia River Basin recently submitted by the Division Engineer, US Army Engineer Division, North Pacific, to the Chief of Engineers under the title "Water Resources Development, Columbia River Basin" dated June 1958.

Flood Control Principle No. 4

The upstream country should be paid one-half of the benefits as measured in Flood Control Principle No. 3, i.e., one-half of the value of the damages prevented.

Discussion of Flood Control Principle No. 4

In the event that application of this principle should indicate a payment to the upstream country greater than the estimated cost of alternative means of obtaining equivalent flood control in the United States the requirement of General Principle No. 2 that there should be an advantage as compared with available alternatives would not be satisfied and consideration should be given to this circumstance in the negotiations.

Flood Control Principle No. 5

The amount due to the upstream country under the foregoing principles should be determined in advance of construction of each storage project. Payments to cover the entire period that the arrangements are to be effective should be made in cash as a lump sum or as periodic amounts as may be agreed upon to the mutual satisfaction of the upstream and downstream countries.

Discussion of Flood Control Principle No. 5

The payment of a lump sum or periodic amount as may be agreed upon would, of course, be subject to the authorization of such payment by the Congress of the United States. Request for such authorization could be presented to the Congress for consideration as soon as a definite arrangement between the two countries became available as a basis for the request.

Flood Control Principle No. 6

In the event of the downstream country requesting special operation for flood control of storage included in the assured plan of operation, beyond the type of operation provided for in such assured plan, the upstream country should be compensated for any loss of power which may result thereform. In the event of the downstream country requesting the operation, for flood control, of storage not included in the assured plan, the upstream country should similiarly be compensated for any loss of power which may be sustained by the upstream country and in addition should be paid on the basis of half the damages prevented by the operation of the storage in question.

Discussion of Flood Control Principle No. 6

This principle is included to provide for emergency operations to meet unusual flood producing conditions not covered in the assured plan of operation discussed under Principle No. 1. As long as operations for flood control remain in conformity with the assured plan of operation, there would be no compensation beyond that provided for in the other power and flood control principles.

If, however, unusual flood producing conditions should occur and, at the request of the downstream country, the upstream country should draw down its storages included in the assured plan to a greater extent or at a different time or in any manner not provided for in the assured plan of operation, the downstream country should compensate the upstream country for the loss of power sustained in providing the additional flood protection. That is, if such action caused a loss of power as compared with the results that would have been possible by adhering to the assured plan of operation, then the upstream country would be reimbursed for the loss of power at its plants and for the decrease in its share of power in the downstream country's plants. The reimbursement could be either in cash or in power as might be mutually agreed upon. In any event, the downstream country should give assurances that it would furnish sufficient power to meet minimum load requirements of the upstream country if the

loss of power were so great as to adversely affect the upstream country's ability to meet the loads from its own resources.

The foregoing arrangements will apply also to upstream storage not in the flood control plan but which is operated in response to the request of the downstream country to give emergency relief. In this case, however, the downstream country should, in addition to the compensation to the upstream country for power loss, make a payment to the upstream country on the basis of half the damages prevented.

Signed at Washington this twenty-ninth day of December 1959.

Eugene W. Weber

A. G. L. McNaughton

Francis L. Adams

J. Lucien Dansereau

D. M. Stephens