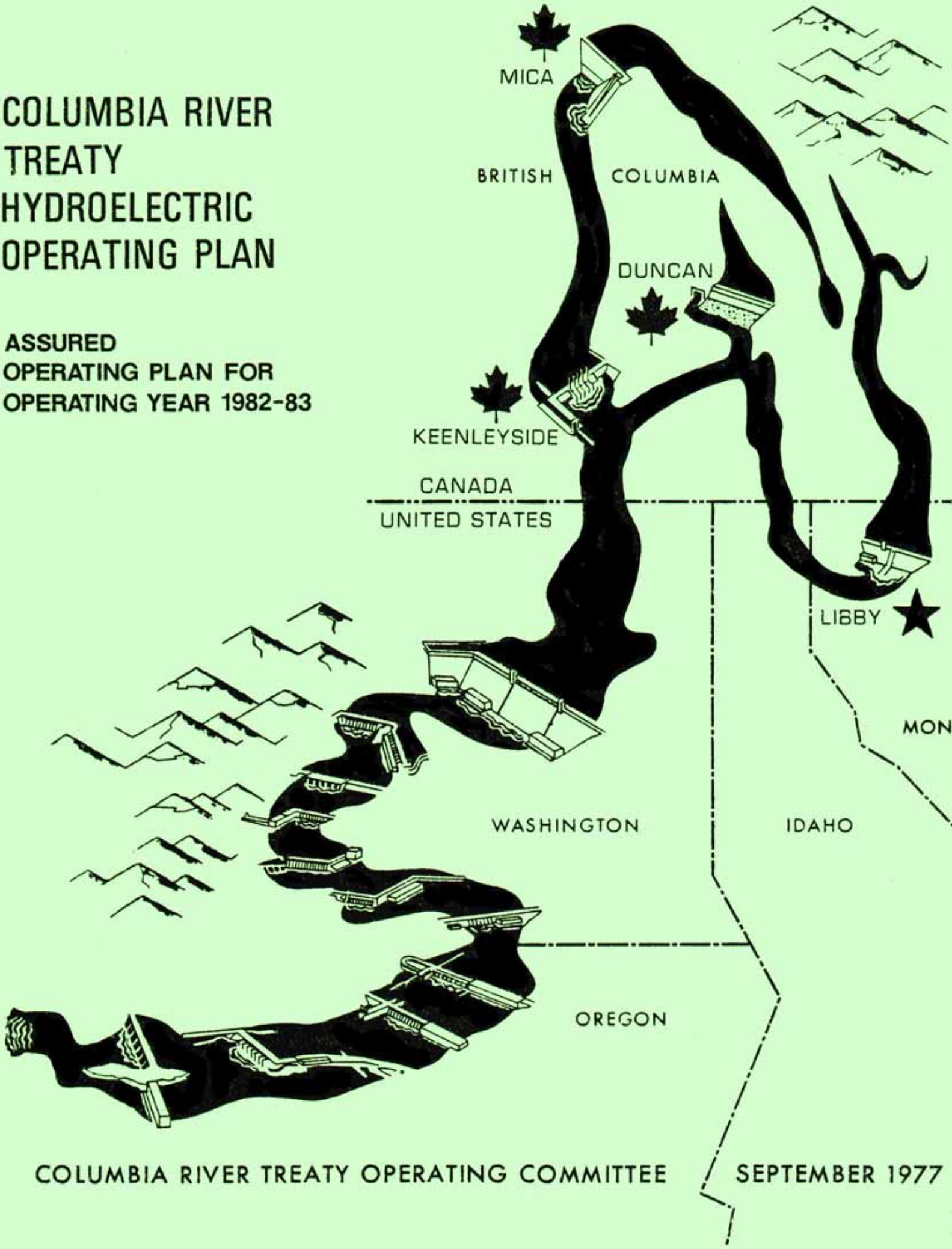
COLUMBIA RIVER TREATY HYDROELECTRIC OPERATING PLAN

ASSURED OPERATING PLAN FOR OPERATING YEAR 1982-83



COLUMBIA RIVER TREATY OPERATING COMMITTEE

SEPTEMBER 1977

COLUMBIA RIVER TREATY
HYDROELECTRIC OPERATING PLAN

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INTRODUCTION

The Treaty between Canada and the United States of America relating to the cooperative development of the water resources of the Columbia River Basin requires that each year an Assured Operating Plan be agreed by the Entities for the operation of the Columbia River Treaty Storage in Canada during the sixth succeeding year. This plan will provide to the Entities information for the sixth succeeding year for planning the power systems in their respective countries which are dependent on or coordinated with the operation of the Canadian storage projects. The data assumed for this Assured Operating Plan will undergo review by the Entities immediately prior to the 1982-83 operating year and such data may be revised to reflect data and criteria current at that time. Should the Entities fail to agree on such revisions, then this Assured Operating Plan will form the basis for the Detailed Operating Plan for 1982-83.

This Assured Operating Plan was prepared in accordance with the Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage.[1] It is based on criteria contained in Annex A and Annex B of the Columbia River Treaty,[2] Article VII of the Protocol,[3] Terms of Sale,[4] and the Columbia River Treaty Flood Control Operating Plan.[5]

The Assured Operating Plan consists of:

(a) The Operating Rule Curve for the whole of the Canadian Treaty Storage, including the Critical Rule Curve, Assured Refill Curve, Variable Refill Curves, and the individual project Upper Rule Curves.

(b) Operating Rules which specifically designate criteria for operation of the Canadian Treaty Projects in accordance with the principles contained in the above references.

A 40-year System Regulation Study[6] was utilized to develop and test the operating rules and rule curves. It contains the agreed-upon operating constraints such as maximum and minimum project elevations and discharges.

SYSTEM REGULATION STUDIES

In accordance with Annex A, Paragraph 7, of the Treaty, the Columbia River Operating Committee conducted system regulation studies reflecting Canadian storage operation for optimum generation in both Canada and the United States. Downstream power benefits were computed with the Canadian storage operation based on the operating rules specified herein. There is a reduction of 5.5 average megawatts of average annual usable energy in the Canadian Entitlement of downstream power benefits. This is within the limits specified by the Treaty.

System Regulation Studies for the Assured Operating Plan were based on 1982-83 estimated loads and resources in British Columbia and in the United States Pacific Northwest System. The Entities have agreed that

the 1982-83 Assured Operating Plan would be based on a 40-year streamflow period and an operating year of 1 August to 31 July. Historical flows for the period August 1928 through July 1968, modified to estimated 1982-83 conditions,[7] were used.

The Critical Rule Curve for these studies was determined from Bonneville Power Administration Study 83-41. The study indicated a 42½-month critical period for the United States system resulting from the low flows during the period from 16 August 1928 through February 1932. It was assumed that all reservoirs, both in the United States and Canada, were full at the beginning of the critical period.

In the studies, individual project flood control criteria were followed. Although only 7.0 million acre-feet of usable storage at Mica is committed for power operation purposes under the Treaty, the studies incorporate Upper Rule Curves designed to evacuate Mica storage up to the full storage of 12 million acre-feet as specified by the Columbia River Treaty Flood Control Operating Plan. Flood Control and Variable Refill Criteria are based on historical inflow volumes.

DETERMINATION OF OPTIMUM GENERATION IN CANADA AND THE UNITED STATES

In order to determine whether optimum generation in both Canada and the United States was achieved in the system regulation studies, the following three quantities were computed for both the Canadian and United States systems:

(a) firm energy capability

(b) January peaking capability

(c) average annual usable secondary energy

In the studies for the 1982-83 Assured Operating Plan the Canadian storage operation was modified to achieve a weighted sum of the three quantities that was greater than the weighted sum achieved under an operation of Canadian storage for optimum generation in the United States alone.

The table on page 5 shows the results from the studies adopted for the 1982-83 Assured Operating Plan and from studies designed to achieve optimum generation in the United States.

The Columbia River Treaty Operating Committee agreed that for the 1982-83 Assured Operating Plan the three quantities would be assigned the following relative values:

> firm energy (Av. MW): January peaking capability (MW): average annual usable secondary energy (Av. MW) were related in the ratio 3:1:2.

The three quantities were added after weighting on this basis and there was a net gain to the combined Canadian and United States systems with the study designed for optimum generation in Canada and the United States.

OPERATING RULE CURVES

The operation of Canadian storage during the 1982-83 Operating Year shall be guided by an Operating Rule Curve for the whole of Canadian storage, and by Flood Control Storage Reservation Curves for the individual projects. The Operating Rule Curve is derived from the various curves described below. These curves are first determined for the

COMPARISON OF STUDY RESULTS

	Optimum Generation in Canada and the United States Study No. 83-41	Optimum Generation in the United States Study No. 83-11	Loss	Gain	Net Gain
1. Firm Energy Capability (Av. MW)					
U.S. System[1/]	12,403	12,403	-	-	
Canada (Mica + Rev.)[2/]	1,522	1,473	-	49	
Total (Av. MW)	13,925	13,876	-	49	49
2. January Peaking Capacity (MW)					
U.S. System[3/]	30,852	30,828	-	24	
Canada (Mica + Rev.)[4/]	2,998	2,966	-	32	
Total (MW)	33,850	33,794	-	56	56
3. Average Annual Usable Secondary Energy (Av. MW)					
U.S. System	3,334	3,323	-	11	
Canada (Mica + Rev.)	132	157	25	-	
Total (Av. MW)	3,466	3,480	25	11	(14)

1/ U.S. System firm energy capability was determined over the U.S. system critical period beginning 16 August 1928 and ending February 29, 1932.

2/ Canadian (Mica + Revelstoke) system firm energy capability was determined over the Canadian system critical period beginning 1 October 1940 and ending 30 April 1946.

3/ U.S. system January peaking capability was determined from January 1937.

4/ Canadian (Mica + Revelstoke) system January peaking capability was determined from second lowest January peak in 40 years of record for the Canadian system.

individual Canadian storages and then summed to obtain the values for the whole of usable Canadian storage given by the composite tables included in this Plan. This is in accordance with the provision of Article VII(2) of the Protocol.

(a) Critical Rule Curve. The Critical Rule Curve indicates the end-of-month storage content of Canadian storage during the critical period. It is designed to protect the ability of the United States system to serve firm load and to protect the firm level of Mica generation with the occurrence of flows no worse than those during the most adverse historical streamflow period. A tabulation of the Composite Critical Rule Curve for the whole of Canadian storage is included in Table 1.

(b) Refill Curve. The Refill Curve is a guide to operation of Canadian storage which defines the normal limit of storage draft for secondary energy in order to provide a high probability of refilling the storage. In general, the Operating Plan does not permit serving secondary loads at the risk of failing to refill storages and thereby jeopardizing the firm load carrying capability of the system or the Mica generating plant during subsequent years. The end of the refill period is considered to be 31 July.

The Refill Curve is, in turn, defined by two curves as discussed below. In each case, adjustment should be made for water required for refill of upstream reservoirs when applicable.

(1) Assured Refill Curve. The Assured Refill Curve indicates the end-of-month storage content required to assure refill of Canadian storage based on the 1930-31 water year, the system's second lowest

historical volume of inflow for the period January through July as measured at The Dalles, Oregon. The tabulation of the composite Assured Refill Curve for the whole of Canadian storage is included as Table 2.

The curve was based on higher flows than the minimum discharge requirements for the period January through July. The schedule of outflows is the same as the Power Discharge Requirements used in computing the Variable Refill Curve discussed in (2) below when The Dalles volume runoff is at 80 million acre-feet.

(2) Variable Refill Curve. The Variable Refill Curve gives end-of-month storage contents for the period January through July required to refill Canadian storage based on historical inflow volume and specified Power Discharge Requirements during the refill period. In the system regulation studies the Power Discharge Requirement was made a function of the natural January - July runoff volume at The Dalles, Oregon. In those years when this volume was lower than 80 million acre-feet, the discharge used was that required to meet firm loads while refilling at 80 million acre-feet. In years when the runoff volume at The Dalles exceeded 95 million acre-feet the Power Discharge Requirement was the project minimum outflow. For intermediate volumes the Power Discharge Requirement was interpolated linearly between the values shown below. The following are the January through July Power Discharge Requirements used in computing the Variable Refill Curves.

Power Discharge Requirements in cfs
For January through July Volume at The Dalles

	80 MAF			90 MAF			95 MAF
Project	Jan Feb Mar	Apr May Jun	Jul	Jan Feb Mar	Apr May Jun	Jul	All Periods
Mica	3,000	11,600	14,600	3,000	6,300	8,300	3,000
Arrow	5,000	17,500	34,500	5,000	9,600	14,000	5,000
Duncan	100	1,700	1,700	100	900	900	100

Composite Variable Refill Curves for the whole of Canadian storage for the 40 years of historical record are recorded in Table 3. These illustrate the probable range of these curves based on historical conditions. In the actual operation in 1982-83, the Power Discharge Requirements will be based on the forecast of unregulated runoff at The Dalles.

(c) Upper Rule Curve. The Upper Rule Curves[8] give end-of-month storage content to which each individual Canadian storage project shall be evacuated for flood control and other requirements. The Upper Rule Curves used in the studies were based upon Flood Control Storage Reservation Diagrams contained in the Columbia River Treaty Flood Control Operating Plan and analysis of system flood control simulations. Flood control curves for the 40-year study period are shown on Tables 4, 5 and 6. Table 5 and 6 reflect an assumed transfer of 2 million acre-feet of storage space from Arrow to Mica. In actual operation, the Flood Control Storage Reservation Curves will be based on the Flood Control Operating Plan, using the latest forecast of runoff available at that time.

(d) Definition of Operating Rule Curve. During the period 1 August through 31 December, the Operating Rule Curve is defined by the Critical Rule Curve or the Assured Refill Curve, whichever is higher. The Critical Rule Curve for the first year of the critical period is used in the foregoing determination. Beginning 1 January, the Operating Rule Curve is defined by first determining the higher of the Critical Rule Curve and the Assured Refill Curve, unless the Variable Refill Curve is below the above-determined value; then it is defined by the Variable Refill Curve, but in no case shall it be lower than a Rule Curve developed using 1936-37 hydro conditions during the period January 1 through March 31. The Operating Rule Curve meets all requirements for flood control operation (except as noted in paragraph (d) of the Operating Rules). Composite Operating Rule Curves for the whole of Canadian storage for all 40 years of historical record are included as Table 7 to illustrate the probable future range of these curves based on historical conditions.

OPERATING RULES

The following rules, used in the System Regulation Study, will apply to the operation of Canadian storage in the 1982-83 Operating Year.

(a) The whole of the Canadian storage may be drafted to its Operating Rule Curve as required to produce optimum generation in Canada and the United States in accordance with Annex A, Paragraph 7, of the Treaty, subject to project physical characteristics, operating constraints, and the criteria for the Mica project listed in (e) below.

(b) The whole of the Canadian storage will not be drafted below its Operating Rule Curve unless:

(1) Reservoir storage in the United States system has been drafted to its refill curve.

(2) Deliveries of secondary energy in the United States are discontinued.

(3) Committed firm thermal and miscellaneous resources not displaced by surplus firm hydro resources are in operation or other replacement energy has been secured from sources other than those committed.

(c) When the conditions of (b) above are met, and it is necessary to draft additional storage to produce optimum generation as determined by the Critical Period System Regulation study, the whole of the Canadian storage and reservoir storage in the United States system will be drafted proportionately between its Operating Rule Curve or Energy Content Curve, respectively, and its Critical Rule Curve. The proportionate draft will be made, if necessary, first to the first year Critical Rule Curve, then between the first and second year Critical Rule Curve, the second and third year Critical Rule Curve, etc. When it is necessary to operate the whole of the Canadian storage and the United States reservoir storage below their lowest Critical Rule Curves, each shall be operated proportionately between its lowest Critical Rule Curve and its normal minimum content, except that Mica Reservoir will continue to be operated in accordance with (e) below, so as to optimize generation at site as well as downstream in the United States. In the event the Mica operation results in less than that project's proportional share of draft from the whole of Canadian storage, compensating drafts will be made from Arrow to the extent possible.

(d) Each project will be operated on or below the storage content defined by its Upper Rule Curve, unless such content is below that indicated by the Variable Refill Curve.

(e) Mica project will be operated to the following monthly criteria as qualified in (1) to (3) below:

Mica Project Operating Criteria

Month	Target End-of-Period Storage Content (KSFD)	Target Average Outflow (CFS)	Minimum Outflow (CFS)
August 1-15	N/A	10,000	10,000
August 16-31	10,121.1	N/A	10,000
September	10,121.1	N/A	10,000
October	N/A	14,000	10,000
November	N/A	19,000	10,000
December	N/A	23,000	15,000
January	N/A	23,000	15,000
February	N/A	23,000	15,000
March	N/A	20,000	15,000
April 1-15	N/A	18,000	15,000
April 16-30	N/A	15,000	15,000
May	N/A	10,000	10,000
June	N/A	10,000	10,000
July	N/A	10,000	10,000

(N/A - not applicable)

(1) Mica monthly outflows will be increased in the months from October to June if required to avoid violation of the Upper Rule Curve.

(2) Mica monthly average outflows will be increased in the months from August 16-31 to March and the months of May and June if the Arrow reservoir storage in the previous month is within the following limits.

Month	Arrow Reservoir End-of-Month Storage Content (KSFD)	Mica Outflow in Next Month (CFS)
August 1-15	0 - 2,000	20,000
August 16-31	0 - 2,000	20,000
September	0 - 2,000	30,000
October	3,400 - 3,579.6 0 - 2,000	12,000 34,000
November	0 - 1,500	34,000
December	0 - 2,500	30,000
January	0 - 1,400	30,000
February	0 - 100	25,000
March	-	-
April 1-15	-	-
April 16-30	0 - 600	16,000
May	0 - 1,400	20,000
June	-	-
July	-	-

(3) Under this Assured Operating Plan, Mica storage releases in excess of the 7 million acre-feet that are required to maintain the minimum Mica outflows specified under this plan will be retained in the Arrow reservoir, subject to flood control criteria at Arrow. The total combined storage draft from Mica and Arrow will not exceed 14.1 million

acre-feet unless flood control criteria will not permit the additional Mica storage releases for minimum flow purposes to be retained at Arrow.

The present British Columbia Hydro and Power Authority generation plans recommend construction of the Revelstoke project for service in 1982. The present construction schedule calls for the following in-service dates:

Units 1 and 2	September 1982
Unit 3	December 1982
Unit 4	June 1983

Revelstoke project has been included in the 1982-83 Assured Operating Plan and has been operated as a run-of-river project. As the Revelstoke reservoir encroaches upon the Mica project tailrace area, there is a reduction in Mica project firm energy capability of approximately 20 average megawatts.

IMPLEMENTATION

The Entities have agreed that each year a Detailed Operating Plan will be prepared for the immediately succeeding operating year. Such Detailed Operating Plans are made under authority of Article XIV 2.(k) of the Columbia River Treaty which states:

". . . the powers and the duties of the entities include:

(k) preparation and implementation of detailed operating plans that may produce results more advantageous to both countries than those that would arise from operation under the plans referred to in Annexes A and B."

The Detailed Operating Plan for 1982-83 will reflect the latest available load, resource, and other pertinent data to the extent the Entities agreed these data should be included in the plan. Beginning on 1 January 1982, the Assured Operating Plan contained herein will be reviewed and the data and criteria updated, as agreed by the Entities, to form the basis for a Detailed Operating Plan for the 1982-83 Operating Year. Failing agreement on updating the Assured Operating Plan, the Detailed Operating Plan will include all data and criteria given in this Assured Operating Plan. Actual operation during the 1982-83 Operating Year shall be guided by the Detailed Operating Plan.

The operating rules to be used in implementation of the Detailed Operating Plan are generally the same as the operating rules described in this document.

The values used in the study to define the various rule curves were month-end values only. In actual day-to-day operation it is necessary to operate in such a manner during the course of each month that these month-end values can be observed in accordance with the operating rules. Because of the normal variation of power load and streamflow during any month, straight line interpolation between the month-end points should not be assumed.

During the storage drawdown season, Canadian storage should not be drafted below its month-end point at any time during the month unless it can be conservatively demonstrated that sufficient inflow is available, in excess of the minimum outflow required to serve power demand, to refill the reservoir to its end-of-month value as required. During the

storage evacuation and refill season, operation will be consistent with the Flood Control Operating Plan. When refill of Canadian storage is being guided by Flood Control Refill Curves,[5] such curves will be computed on a day-by-day basis using the residual volume-of-inflow forecasts depleted by the volume required for minimum outflow from each day through the end of the refill season.

REFERENCES

[1] Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans for Canadian Treaty Storage dated 25 July 1967.

[2] Treaty between Canada and the United States of America relating to Cooperative Development of the Water Resources of the Columbia River Basin dated 17 January 1961.

[3] Protocol -- Annex to Exchange of Notes dated 22 January 1964.

[4] Terms of Sales -- Attachment to Exchange of Notes dated 22 January 1964.

[5] Columbia River Treaty Flood Control Operating Plan dated October 1972.

[6] BPA Hydroelectric Power Planning Program, Assured Operating Plan 40-year System Regulation Study 83-41, dated 15 July 1977.

[7] Provisional Report on Modified Flows at Selected Sites, 1928 to 1968 for the 1970 and 2020 Level of Development, Columbia River and Coastal Basins, Columbia River Water Management Group, Revision 2, dated April 1974 and May 1974, respectively.

[8] Summary of End-of-month Reservoir Storage Requirement from Columbia River Flood Regulation Studies dated April 1973 and as updated March 1975.

COLUMBIA RIVER TREATY
COMPOSITE CRITICAL RULE CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1982-83 OPERATING YEAR

TABLE 1

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1ST YR	7814.6	7812.0	7562.9	7377.3	7208.9	5842.1	3698.1	1859.8	1880.2	1648.9	1453.8	2762.5	6088.2	7330.9
2ND YR	7696.9	7724.0	7370.0	6987.6	6184.2	4838.8	2542.4	1571.7	1320.0	1021.5	1138.3	2683.7	5370.4	7113.9
3RD YR	7443.9	7532.4	7317.3	6948.2	6184.2	4567.3	2537.3	1359.7	1269.7	992.8	783.7	2111.4	4296.5	5470.3
4TH YR	5517.5	5399.2	5146.3	4504.4	3325.8	1283.8	393.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

COLUMBIA RIVER TREATY
COMPOSITE ASSURED REFILL CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1982-83 OPERATING YEAR

TABLE 2

AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
37.8	123.3	797.7	1041.5	1103.9	1169.9	1227.4	1259.4	1358.1	1263.6	1274.5	2931.7	5997.7	7814.6

COLUMBIA RIVER TREATY
COMPOSITE VARIABLE REFILL CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1982-83 OPERATING YEAR

TABLE 3

FLOW YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29							4678.3	4703.7	5068.9	5026.2	4983.6	5490.7	6954.0	7814.6
1929-30							2788.2	2468.2	2545.2	2729.2	2912.9	4338.1	6695.9	,,
1930-31							3164.3	2925.6	3316.2	3364.5	3412.6	4308.3	6850.4	,,
1931-32							1897.4	960.5	221.4	0.0	0.0	1224.5	5173.2	,,
1932-33							,,	,,	,,	,,	,,	1195.3	4860.3	,,
1933-34							,,	,,	,,	2.7	5.3	1528.7	5691.0	,,
1934-35							,,	977.1	579.5	590.8	691.9	2316.9	5479.7	,,
1935-36							,,	960.5	480.3	408.6	426.9	2410.0	6152.9	,,
1936-37							4880.8	4900.6	5248.8	5232.9	5217.0	5661.1	6972.1	,,
1937-38							1897.4	960.5	221.4	157.2	314.4	2169.3	5521.9	,,
1938-39							2814.9	2493.1	2704.3	2809.2	2914.2	4181.5	6958.1	,,
1939-40							2314.2	2005.4	2178.9	2383.5	2588.1	3870.5	6785.5	,,
1940-41							3779.6	3700.7	4137.9	4385.6	4633.2	5621.5	7026.9	,,
1941-42							2305.5	1959.6	1941.7	2094.1	2246.6	3561.4	6229.8	,,
1942-43							1952.8	1582.6	1531.9	1774.3	2016.7	3664.3	5969.4	,,
1943-44							5772.8	5769.7	6147.1	6054.7	5962.3	6136.2	7181.7	,,
1944-45							4856.1	4871.4	5294.6	5276.0	5257.6	5691.2	7011.6	,,
1945-46							1897.4	960.5	221.4	0.0	0.0	1222.2	5366.5	,,
1946-47							,,	,,	,,	,,	,,	1906.7	5525.8	,,
1947-48							,,	,,	,,	,,	,,	1397.7	5353.6	,,
1948-49							2046.8	1519.0	1433.8	1827.3	2221.8	3703.2	6712.6	,,
1949-50							1897.4	960.5	221.4	5.7	11.4	1563.6	4839.5	,,
1950-51							,,	,,	,,	81.5	163.0	1924.8	5611.8	,,
1951-52							,,	,,	,,	204.7	405.3	2333.9	5737.6	,,
1952-53							,,	,,	651.7	835.3	1036.5	2577.0	5666.2	,,
1953-54							,,	,,	221.4	0.0	0.0	912.8	4792.7	,,
1954-55							,,	,,	,,	134.3	268.7	1935.6	4954.5	,,
1955-56							,,	,,	,,	0.0	0.0	1633.5	5434.5	,,
1956-57							,,	,,	,,	,,	,,	1507.5	5859.7	,,
1957-58							,,	,,	,,	,,	,,	1330.5	5492.8	,,
1958-59							,,	,,	,,	,,	,,	1091.8	4884.2	,,
1959-60							,,	,,	,,	232.2	448.5	2195.0	5254.9	,,
1960-61							,,	,,	,,	0.0	0.0	1138.8	5160.3	,,
1961-62							,,	,,	296.8	284.3	374.8	2294.4	5469.6	,,
1962-63							,,	,,	221.4	341.2	608.6	2406.1	5555.6	,,
1963-64							,,	,,	,,	8.4	16.7	1047.7	4640.3	,,
1964-65							,,	,,	,,	145.5	291.1	2231.4	5446.8	,,
1965-66							,,	,,	240.5	155.9	255.7	1764.4	5432.5	,,
1966-67							,,	,,	221.4	0.0	0.0	134.9	4227.8	,,
1967-68							,,	,,	,,	,,	,,	826.1	4752.6	,,

FLOOD CONTROL STORAGE RESERVATION CURVES
DUNCAN
KSFD
1982-83 OPERATING YEAR

TABLE 4

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	705.8	705.8	705.8	705.8	705.8	504.1	397.2	303.0	303.0	311.0	324.6	416.4	560.6	705.8
1929-30	"	"	"	"	"	"	385.7	281.3	281.3	289.9	304.0	400.8	553.0	"
1930-31	"	"	"	"	"	"	368.5	248.0	248.0	257.1	272.7	377.1	540.9	"
1931-32	"	"	"	"	"	"	272.2	65.5	65.5	80.6	108.9	281.3	609.5	"
1932-33	"	"	"	"	"	"	"	"	"	75.1	94.2	191.5	573.2	"
1933-34	"	"	"	"	"	"	"	"	"	65.5	127.0	339.8	605.5	"
1934-35	"	"	"	"	"	"	"	"	"	"	83.7	187.0	488.0	"
1935-36	"	"	"	"	"	"	"	"	"	71.1	119.5	351.9	705.8	"
1936-37	"	"	"	"	"	"	353.9	219.8	219.8	229.4	246.0	356.9	538.9	"
1937-38	"	"	"	"	"	"	272.2	65.5	65.5	77.1	83.7	217.3	542.4	"
1938-39	"	"	"	"	"	"	"	"	"	82.6	107.4	385.7	705.8	"
1939-40	"	"	"	"	"	"	"	"	"	78.1	103.8	"	"	"
1940-41	"	"	"	"	"	"	321.1	156.3	156.3	167.3	186.0	311.0	508.2	"
1941-42	"	"	"	"	"	"	302.0	121.0	121.0	131.0	155.2	291.9	483.0	"
1942-43	"	"	"	"	"	"	305.0	126.0	126.0	141.1	172.9	248.0	647.8	"
1943-44	"	"	"	"	"	"	392.7	294.4	294.4	302.5	316.6	410.4	557.6	"
1944-45	"	"	"	"	"	"	361.5	234.4	234.4	235.9	236.9	349.9	567.7	"
1945-46	"	"	"	"	"	"	272.2	65.5	65.5	75.6	95.8	322.1	647.3	"
1946-47	"	"	"	"	"	"	"	"	"	77.1	101.8	314.1	629.7	"
1947-48	"	"	"	"	"	"	"	"	"	65.5	65.5	300.4	705.8	"
1948-49	"	"	"	"	"	"	348.3	208.7	208.7	215.2	236.9	408.8	"	"
1949-50	"	"	"	"	"	"	272.2	65.5	65.5	72.1	84.7	184.0	525.3	"
1950-51	"	"	"	"	"	"	"	"	"	79.6	103.3	285.3	534.4	"
1951-52	"	"	"	"	"	"	"	"	"	65.5	67.5	92.2	255.1	"
1952-53	"	"	"	"	"	"	"	"	"	72.1	84.7	234.4	522.8	"
1953-54	"	"	"	"	"	"	"	"	"	73.1	84.2	235.9	547.5	"
1954-55	"	"	"	"	"	"	"	"	"	72.1	80.6	154.7	488.5	"
1955-56	"	"	"	"	"	"	"	26.7	26.7	26.7	26.7	239.9	578.2	"
1956-57	"	"	"	"	"	"	"	65.5	65.5	74.6	89.7	376.1	655.9	"
1957-58	"	"	"	"	"	"	"	"	"	77.1	96.3	359.4	705.8	"
1958-59	"	"	"	"	"	"	"	"	"	65.5	65.5	129.5	513.7	"
1959-60	"	"	"	"	"	"	"	"	"	"	"	161.3	545.5	"
1960-61	"	"	"	"	"	"	"	"	"	"	"	193.6	705.8	"
1961-62	"	"	"	"	"	"	"	"	"	"	78.1	"	545.5	"
1962-63	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1963-64	"	"	"	"	"	"	"	"	"	"	65.5	161.3	513.7	"
1964-65	"	"	"	"	"	"	"	"	"	"	129.5	225.3	545.5	"
1965-66	"	"	"	"	"	"	"	"	"	"	97.3	"	"	"
1966-67	"	"	"	"	"	"	"	"	"	"	65.5	193.6	577.7	"
1967-68	"	"	"	"	"	"	"	"	"	"	"	"	513.7	"

FLOOD CONTROL STORAGE RESERVATION CURVES
ARROW
KSFO
1982-83 OPERATING YEAR

TABLE 5

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	3579.6	3579.6	3579.6	3453.6	3453.6	3075.4	3075.4	3075.4	3075.4	3088.5	3111.2	3235.8	3579.6	3579.6
1929-30	"	"	"	"	"	"	3060.8	3047.7	3033.1	3047.2	3071.9	3207.0	"	"
1930-31	"	"	"	"	"	"	3075.4	3075.4	3075.4	3088.5	3111.2	3235.8	"	"
1931-32	"	"	"	"	"	"	2364.6	1719.2	1008.3	1015.9	1126.8	2224.4	"	"
1932-33	"	"	"	"	"	"	"	"	"	1008.3	1036.6	1761.6	3834.6	"
1933-34	"	"	"	"	"	"	"	"	"	"	1784.8	2327.2	3579.6	"
1934-35	"	"	"	"	"	"	"	"	"	"	1008.3	1725.8	3834.6	"
1935-36	"	"	"	"	"	"	"	"	"	1069.9	1373.4	2134.7	3579.6	"
1936-37	"	"	"	"	"	"	2998.3	2927.7	2850.6	2869.7	2902.5	3082.5	"	"
1937-38	"	"	"	"	"	"	2364.6	1719.2	1008.3	1083.0	1278.1	1831.1	3147.5	"
1938-39	"	"	"	"	"	"	2637.8	2243.6	1805.9	1869.5	1983.4	2735.1	3579.6	"
1939-40	"	"	"	"	"	"	2849.6	2645.4	2420.0	2454.8	2536.0	2999.8	"	"
1940-41	"	"	"	"	"	"	3075.4	3075.4	3075.4	3088.5	3111.2	3235.8	"	"
1941-42	"	"	"	"	"	"	2364.6	1719.2	1008.3	1064.8	1149.5	1934.8	"	"
1942-43	"	"	"	"	"	"	"	"	"	1111.2	1321.9	1440.4	2389.3	"
1943-44	"	"	"	"	"	"	3075.4	3075.4	3075.4	3088.5	3111.2	3235.8	3579.6	"
1944-45	"	"	"	"	"	"	2641.8	2251.6	1818.0	1842.7	1908.3	2477.0	3368.4	"
1945-46	"	"	"	"	"	"	2364.6	1719.2	1008.3	1072.4	1242.3	2201.2	3579.6	"
1946-47	"	"	"	"	"	"	"	"	"	1075.4	1360.8	2147.3	"	"
1947-48	"	"	"	"	"	"	"	"	"	1036.6	1183.3	2216.8	"	"
1948-49	"	"	"	"	"	"	"	"	"	1144.5	1375.9	2494.6	"	"
1949-50	"	"	"	"	"	"	"	"	"	1103.6	1113.7	1113.7	2232.5	"
1950-51	"	"	"	"	"	"	"	"	"	1052.2	1101.1	1355.2	3338.1	"
1951-52	"	"	"	"	"	"	"	"	"	1069.9	1345.1	1792.3	3813.9	"
1952-53	"	"	"	"	"	"	"	"	"	1057.3	1172.7	1476.2	"	"
1953-54	"	"	"	"	"	"	"	"	"	"	1134.4	1628.0	1898.2	"
1954-55	"	"	"	"	"	"	"	"	"	1075.4	1090.5	1653.7	3224.7	"
1955-56	"	"	"	"	"	"	"	857.1	0.0	0.0	289.9	1367.3	2763.4	"
1956-57	"	"	"	"	"	"	"	1719.2	1008.3	1077.9	1224.1	2651.4	3579.6	"
1957-58	"	"	"	"	"	"	"	"	"	1046.7	1190.9	2242.5	"	"
1958-59	"	"	"	"	"	"	"	"	"	1008.3	1008.3	1394.0	3322.5	"
1959-60	"	"	"	"	"	"	"	"	"	"	"	1779.7	3579.6	"
1960-61	"	"	"	"	"	"	"	"	"	"	"	1651.2	"	"
1961-62	"	"	"	"	"	"	"	"	"	"	"	2036.8	3322.5	"
1962-63	"	"	"	"	"	"	2484.5	1950.1	1359.2	1359.2	1359.2	1914.3	3579.6	"
1963-64	"	"	"	"	"	"	2364.6	1719.2	1008.3	1008.3	1008.3	1265.5	3322.5	"
1964-65	"	"	"	"	"	"	"	"	"	"	"	1651.2	3579.6	"
1965-66	"	"	"	"	"	"	2528.4	2034.8	1487.8	1487.8	1487.8	2324.7	"	"
1966-67	"	"	"	"	"	"	2364.6	1719.2	1008.3	1008.3	1008.3	1394.0	3322.5	"
1967-68	"	"	"	"	"	"	2367.1	1723.8	1015.4	1015.4	1015.4	1528.6	3579.6	"

FLOOD CONTROL STORAGE RESERVATION CURVES
MICA
KSFO
1982-83 OPERATING YEAR

TABLE 6

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	3529.2	3529.2	3529.2	3428.4	3428.4	3428.4	3406.7	3387.0	3365.3	3369.9	3380.5	3412.2	3469.7	3529.2
1929-30	"	"	"	"	"	"	3378.5	3332.6	3282.7	3290.2	3305.9	3353.2	3440.0	"
1930-31	"	"	"	"	"	"	3428.4	3428.4	3428.4	3431.4	3437.9	3457.1	3492.9	"
1931-32	"	"	"	"	"	"	3100.7	2808.2	2480.5	2511.8	2577.8	2781.5	3149.6	"
1932-33	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1933-34	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1934-35	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1935-36	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1936-37	"	"	"	"	"	"	3353.2	3283.7	3208.5	3218.1	3238.3	3300.8	3413.2	"
1937-38	"	"	"	"	"	"	3100.7	2808.2	2480.5	2511.8	2577.8	2781.5	3149.6	"
1938-39	"	"	"	"	"	"	3213.1	3018.5	2806.7	2828.4	2873.8	3013.9	3267.5	"
1939-40	"	"	"	"	"	"	3296.8	3174.3	3042.7	3057.3	3088.1	3182.3	3353.2	"
1940-41	"	"	"	"	"	"	3428.4	3428.4	3428.4	3431.4	3437.9	3457.1	3492.9	"
1941-42	"	"	"	"	"	"	3100.7	2808.2	2480.5	2511.8	2577.8	2781.5	3149.6	"
1942-43	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1943-44	"	"	"	"	"	"	3428.4	3428.4	3428.4	3431.4	3437.9	3457.1	3492.9	"
1944-45	"	"	"	"	"	"	3214.6	3021.5	2811.3	2832.9	2878.3	3017.5	3269.6	"
1945-46	"	"	"	"	"	"	3100.7	2808.2	2480.5	2511.8	2577.8	2781.5	3149.6	"
1946-47	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1947-48	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1948-49	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1949-50	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1950-51	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1951-52	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1952-53	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1953-54	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1954-55	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1955-56	"	"	"	"	"	3025.0	2067.1	1058.8	100.9	100.9	100.9	803.7	2363.6	"
1956-57	"	"	"	"	"	3428.4	3100.7	2808.2	2480.5	2511.8	2577.8	2781.5	3149.6	"
1957-58	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1958-59	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1959-60	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1960-61	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1961-62	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1962-63	"	"	"	"	"	"	3150.6	2902.0	2626.7	2654.0	2710.4	2885.9	3202.5	"
1963-64	"	"	"	"	"	"	3100.7	2808.2	2480.5	2511.8	2577.8	2781.5	3149.6	"
1964-65	"	"	"	"	"	"	"	"	"	"	"	"	"	"
1965-66	"	"	"	"	"	"	3168.7	2936.3	2680.2	2705.9	2759.3	2923.7	3221.7	"
1966-67	"	"	"	"	"	"	3100.7	2808.2	2480.5	2511.8	2577.8	2781.5	3149.6	"
1967-68	"	"	"	"	"	"	3101.7	2810.3	2483.6	2514.8	2580.9	2783.5	3150.6	"

COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1982-83 OPERATING YEAR

TABLE 7

FLOW YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	7814.6	7812.0	7562.9	7377.3	7208.9	5842.1	3698.1	1859.8	1882.2	1811.8	1684.7	3274.6	6509.9	7814.6
1929-30	,,	,,	,,	,,	,,	,,	2634.8	1483.1	,,	,,	,,	,,	,,	,,
1930-31	,,	,,	,,	,,	,,	,,	3066.3	1859.8	,,	,,	,,	,,	,,	,,
1931-32	,,	,,	,,	,,	,,	,,	1897.4	790.6	221.4	0.0	0.0	1224.5	5173.2	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1195.3	4860.3	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	2.7	5.3	1528.7	5691.8	,,
1934-35	,,	,,	,,	,,	,,	,,	,,	807.2	579.5	590.8	691.9	2316.9	5479.7	,,
1935-36	,,	,,	,,	,,	,,	,,	,,	790.6	480.3	408.6	426.9	2410.0	6104.3	,,
1936-37	,,	,,	,,	,,	,,	,,	3698.1	1859.8	1882.2	1811.8	1684.7	3274.6	6509.9	,,
1937-38	,,	,,	,,	,,	,,	,,	1897.4	790.6	221.4	157.2	314.4	2169.3	5521.9	,,
1938-39	,,	,,	,,	,,	,,	,,	2814.9	1599.8	1823.9	1803.7	1684.7	3248.2	6509.9	,,
1939-40	,,	,,	,,	,,	,,	,,	2314.2	1462.3	1820.0	1805.9	,,	3250.5	,,	,,
1940-41	,,	,,	,,	,,	,,	,,	3569.8	1859.8	1882.2	1811.8	,,	3274.6	,,	,,
1941-42	,,	,,	,,	,,	,,	,,	2305.5	1179.7	1670.8	1777.1	1677.1	3247.7	6207.8	,,
1942-43	,,	,,	,,	,,	,,	,,	1952.8	827.5	1275.8	1500.2	1593.9	3222.3	5969.4	,,
1943-44	,,	,,	,,	,,	,,	,,	3698.1	859.8	1882.2	1811.8	1684.7	3274.6	6509.9	,,
1944-45	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1945-46	,,	,,	,,	,,	,,	,,	1897.4	790.6	221.4	0.0	0.0	1222.2	5366.5	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1906.7	5525.8	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1397.7	5353.6	,,
1948-49	,,	,,	,,	,,	,,	,,	2046.8	1349.1	1370.6	1598.3	1648.0	3236.0	6409.6	,,
1949-50	,,	,,	,,	,,	,,	,,	1897.4	790.6	221.4	5.7	11.4	1563.6	4839.5	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	81.5	163.0	1924.8	5611.8	,,
1951-52	,,	,,	,,	,,	,,	,,	,,	,,	,,	204.7	405.3	2333.9	5737.6	,,
1952-53	,,	,,	,,	,,	,,	,,	,,	,,	651.7	835.3	1036.5	2577.8	5666.2	,,
1953-54	,,	,,	,,	,,	,,	,,	,,	,,	221.4	0.0	0.0	912.8	4792.7	,,
1954-55	,,	,,	,,	,,	,,	,,	,,	,,	,,	134.3	268.7	1935.6	4954.5	,,
1955-56	,,	,,	,,	,,	,,	,,	,,	,,	,,	0.0	0.0	1633.5	5434.5	,,
1956-57	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1507.5	5859.7	,,
1957-58	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1330.5	5492.0	,,
1958-59	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1091.8	4884.2	,,
1959-60	,,	,,	,,	,,	,,	,,	,,	,,	,,	232.2	448.5	2195.0	5254.9	,,
1960-61	,,	,,	,,	,,	,,	,,	,,	,,	,,	0.0	0.0	1138.8	5160.0	,,
1961-62	,,	,,	,,	,,	,,	,,	,,	,,	296.8	284.3	374.8	2294.4	5469.6	,,
1962-63	,,	,,	,,	,,	,,	,,	,,	,,	221.4	341.2	608.6	2406.1	5555.6	,,
1963-64	,,	,,	,,	,,	,,	,,	,,	,,	,,	8.4	16.7	1047.7	4648.3	,,
1964-65	,,	,,	,,	,,	,,	,,	,,	,,	,,	145.5	291.1	2231.4	5446.8	,,
1965-66	,,	,,	,,	,,	,,	,,	,,	,,	240.5	155.9	255.7	1764.4	5432.5	,,
1966-67	,,	,,	,,	,,	,,	,,	,,	,,	221.4	0.0	0.0	134.9	4227.8	,,
1967-68	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	826.1	4752.6	,,

DETERMINATION OF DOWNSTREAM POWER BENEFITS RESULTING FROM CANADIAN STORAGE
FOR OPERATING YEAR 1982-83
September 1977

1. Introduction.

The Treaty between Canada and the United States of America and related documents relating to the cooperative development of the water resources of the Columbia River Basin require that downstream power benefits from Canadian storage be determined in advance by the two Entities. The purpose of this report is to set out the results of downstream power benefit computations for the sixth succeeding year, 1982-83, and for the storage for which the Assured Operating Plan was developed.

The procedures followed in the benefit studies are those provided in Annex A, Paragraph 7; in Annex B of the Treaty; in Articles VIII, IX, and X of the Protocol; and in the document, "Procedures for the Determination of Downstream Power Benefits Resulting from Canadian Storage," dated 9 September 1968.

The Canadian Entitlement Benefits were computed as follows:

Step I - based on the total U.S. planned hydro and thermal system with 15-1/2 maf of Canadian storage operated for optimum generation in both countries (83-41 study).

Step II - based on the U.S. base hydro and thermal system with 15-1/2 maf of Canadian storage operated for optimum generation in both countries (83-42 study).

Step III - based on the U.S. base hydro and thermal system operated for optimum generation in the U.S. (83-13 study).

In addition to the determination of downstream power benefits for the operating year 1982-83, separate determinations were carried out in accordance with the document, "Operating Plans with Mica Generation," dated 15 November 1971, which was agreed by the Entities to implement the provisions of Annex A, Paragraph 7, relating to the limit of year-to-year change in the operation of Canadian storage in operating plans designed to achieve optimum generation at-site in Canada and downstream in Canada and the United States of America.

II. Results of Study.

(a) The Canadian Entitlement, which is one-half the total computed downstream power benefits, was computed to be:

Dependable Capacity	=	1,466.5 MW
Average Annual Energy	=	562.0 MW

(b) One-half of the downstream power benefits determined for 15 maf of Canadian storage operated for optimum generation in the United States was computed to be:

Dependable Capacity = 1,437.0 MW

Average Annual Energy = 562.5 MW

In accordance with Paragraph 5 of the document dated 15 November 1971, the minimum permitted downstream power benefits for the 1982-83 operating year are as follows:

Dependable Capacity = 1,473.5 - (1,473.5 - 1,437.0) = 1,437.0 MW

Average Annual Energy = 597.5 - (600.5 - 562.5) = 559.5 MW

The above computations are based on the formula X - (Y - Z), where the quantities X, Y, and Z, are defined in the 15 November 1971 document. The quantites X and Y are derived from the downstream power benefit computations set out in the 1981-82 agreement. The computed downstream power benefits exceed these amounts.

III. Effect on Canadian Entitlement.

The Canadian Entitlement to downstream power benefits was sold to the United States of America under the Canadian Entitlement Purchase Agreement dated 13 August 1964. By definition, the Canadian Entitlement for 1982-83 which was sold was that which would have been computed if the 1982-83 Assured Operating Plan had been designed to achieve optimum generation downstream in the United States alone. The Canadian Entitlement determined for the conditions above would have been:

Dependable Capacity = 1/2 of 2,933 MW or 1,466.5 MW

Average Annual Energy = 1/2 of 1,135 MW or 567.5 MW

Since the 1982-83 Assured Operating Plan was in fact designed to achieve optimum generation at-site in Canada and downstream in the United States of America, Section 7 of the Agreement requires that "any reduction in the Canadian Entitlement resulting from action taken pursuant to Paragraph 7 of Annex A of the Treaty shall be determined in accordance with Subsection (3) of Section 6 of this Agreement." The Canadian Entitlement of downstream power benefits under the 1982-83 Assured Operating Plan was determined as:

Dependable Capacity = 1/2 of 2,933 MW or 1,466.5 MW

Average Annual Energy = 1/2 of 1,124 MW or 562 MW

The comparison indicates a reduction in Canadian Entitlement of 5.5 average megawatts of average annual usable energy, but no reduction in dependable

capacity. This reduction would be in respect of the period 1 April 1982 through 31 March 1983 in accordance with the document, "Procedures for the Determination of Downstream Power Benefits Resulting from Canadian Storage," dated 9 September 1968.

The Entities are agreed that the United States Entity is entitled to receive during the period 1 April 1982 through 31 March 1983, from B.C. Hydro & Power Authority, 5.5 average megawatts of energy in accordance with Sections 7 and 10 of the Canadian Entitlement Purchase Agreement dated 13 August 1964.

IV. Computation of Entitlement.

The following Tables and Charts are attached and summarize the study:

Table 1. Computation of Canadian Entitlement

The essential elements used in the computation of the Canadian Entitlement as provided in Paragraph 2 and 3 of Annex B are shown in this table.

Table 2. Summary of Power Regulations for the Computation of Canadian Entitlement to Downstream Benefits.

This table summarizes the Step I, II, and III regulations by projects.

Table 3. Determination of Load Shape for Steps II and III, Canadian Entitlement Computation

The load shape for Steps II, and III carry the same ratio between each month and the annual average as does the Pacific Northwest area load. The Northwest area firm loads on this table were based on the current forecast data. The Grand Coulee pumping load is also included in this estimate.

The firm load for Steps II and III is computed as follows:

(1) Estimate the hydro nominal prime power for the critical period;

(2) Add the thermal from Step I less reserve and minimum thermal generation;

(3) Multiply (2) by the ratio of the area annual average firm load to the area critical period firm load to obtain the annual average firm load for Steps II and III (the ratios used in this study were 0.98677 and 0.95544, respectively);

(4) Pro rate the average annual Step II and III load determined in (3) by months in the ratio that each monthly area load bears to the annual average area load; and

(5) Subtract the thermal in each month to obtain the monthly firm load. The average annual hydro loads for Steps II and III also become the firm energy considered usable according to Annex B, Paragraph 3(a).

Chart 1 & 2. Secondary Energy Duration Curve, Steps II and III

These charts are duration curves of the secondary energy for Steps II and III. The secondary energy is the capability each month which exceeds the firm hydro loads shown in Table 3. The usable secondary energy shown in average megawatts for each step is computed in accordance with Annex B, Paragraphs 3(b) and 3(c). The "other usable secondary" was computed on the basis of 40 percent of the remainder after thermal replacement. The thermal replacement was limited to the existing and scheduled thermal energy capability after allowance for reserve and minimum thermal generation, except when an energy surplus condition occurs; then the thermal replacement must not exceed the total of the thermal energy required to supply firm plus the estimated secondary load.

Thermal Energy Capability - MW	7,383 1/
Less Minimum Thermal Generation	1,635
Thermal Replacement - MW	5,748

The following tabulation shows the ordinate values for usable secondary energy:

	Step II	Step III
Thermal Replacement	5,748	5,748
Other	1,705	2,542
Total - MW	7,453	8,290

1/ Thermal energy capabilities are based on an annual plant factor of 60% the first full year of operation and 75% thereafter. These annual plant factors include deductions for energy reserves and scheduled maintenance.

TABLE 1

COMPUTATION OF CANADIAN ENTITLEMENT

Generation Figures are in Average Megawatts; Load Factors, in Percent

Determination of Dependabel Capacity Credited to Canadian Storage

Critical Period Average Rate of Generation with Canadian Storage, Step II	9,090
Critical Period Average Rate of Generation without Canadian Storage, Step III	7,049
Gain Due to Canadian Storage	2,041
Estimated Average Critical Period Load Factor -- Percent	69.581
Dependable Capacity Gain 1/	2,933
Canadian Share of Dependable Capacity	1,466.5

Determination of Increase in Average Annual Usable Energy

Step II (with Canadian Storage)

Annual Firm Hydro Energy	8,894
Thermal Replacement Energy	2,160
Other Usable Secondary Energy	260
System Annual Average Usable Energy	11,314

Step III (without Canadian Storage)

Annual Firm Hydro Energy	6,479
Thermal Replacement Energy	3,068
Other Usable Secondary Energy	643
System Annual Average Usable Energy	10,190

Average Annual Usable Energy Gain	1,124
Canadian Share of Average Annual Energy Gain	562.0

1/ Dependable capacity gain credited to Canadian storage equals gain in critical period average rate of generation divided by the estimated average critical period load factor.

SUMMARY OF POWER REGULATIONS FOR 1982-83
FOR THE
COMPUTATION OF CANADIAN ENTITLEMENT
TO DOWNSTREAM BENEFITS

TABLE 2

PROJECTS	BASIC DATA		STEP I			STEP II				STEP III			
	Number of Units	Nominal Installed Peaking Capacity MW	Usable Storage 1000 AF	January Peaking Capability MW	Critical Period Average Generation MW	Usable Storage 1000 AF	January Peaking Capability MW	Critical Period Average Generation MW	Average Annual Generation MW	Usable Storage 1000 AF	January Peaking Capability MW	Critical Period Average Generation MW	Average Annual Generation MW
CANADIAN													
Mica			7,000			7,000							
Arrow			7,100			7,100							
Duncan			1,400			1,400							
Subtotal			15,500			15,500							
BASE FEDERAL SYSTEM													
Hungry Horse	4	328	3,161	219	98	3,008	229	116	102	3,008	280	213	101
Albeni Falls	3	49	1,155	24	25	1,155	23	23	23	1,155	24	25	25
Grand Coulee	24 + 2	6,415	5,232	6,400	1,999	5,072	6,359	1,771	2,380	5,072	5,970	1,228	2,281
Chief Joseph	27	2,412		2,412	1,087		2,412	1,000	1,324		2,412	711	1,250
Ice Harbor	6	693		693	217		693	223	302		693	170	303
McNary	14	1,127		1,127	640		1,124	590	757		1,124	430	711
John Day	16	2,484	535	2,484	924		2,484	923	1,261		2,484	683	1,226
The Dalles	22	2,018		2,018	818		2,018	794	1,036		2,018	632	1,016
Bonneville	18	1,114		1,114	610		1,114	591	736		1,114	465	704
Subtotal		16,640	10,083	16,491	6,418	9,235	16,456	6,031	7,921	9,235	16,119	4,557	7,617
BASE SYSTEM NON-FEDERAL													
Kootenay Lake (Canadian)			649			427				427			
Kerr	3	160	1,219	150	110	1,219	152	101	114	1,219	150	139	116
Thompson Falls	6	40		40	35		40	39	33		40	37	32
Noxon Rapids	5	542	231	538	148		542	138	210		542	158	210
Cabinet Gorge	4	230		230	105		230	93	123		230	106	124
Box Canyon	4	74		71	46		71	45	48		71	51	48
Coeur d' Alene & Long Lake			327			223				223			
Wells	10	842		842	437		842	409	512		842	289	473
Chelan	2	54	677	51	38	676	50	38	46	676	51	49	44
Rocky Reach	11	1,267		1,267	589		1,267	553	712		1,267	393	668
Rock Island	18	544		544	278		544	262	330		544	182	303
Wanapum	10	986		986	557		986	524	657		986	367	598
Priest Rapids	10	912		912	530		912	498	619		912	357	565
Brownlee	4	450	980	450	211	974	450	250	262	974	450	250	255
Oxbow	4	220		220	89		220	109	116		220	114	116
Subtotal		6,321	4,083	6,301	3,173	3,519	6,306	3,059	3,782	3,519	6,305	2,492	3,552
TOTAL BASE SYSTEM HYDRO		22,961	29,666	22,792	9,591	28,254	22,762	9,090	11,703	12,754	22,424	7,049	11,169
ADDITIONAL STEP I PROJECTS													
Libby	4	483	4,934	368	189								
Boundary	4	650		650	358								
Spokane River Plants		153		152	89								
Hells Canyon	3	450		435	174								
Dworshak	3	460	2,015	439	163								
Lower Granite	6	930		930	217								
Little Goose	6	930		930	217								
Lower Monumental	6	930		930	216								
Pelton and Round Butte		454	274	438	124								
Subtotal		5,440	7,223	5,272	1,747								
Independent Resources		4,842	8,353	4,096	1,732								
TOTAL HYDRO RESOURCES		33,243	45,242	32,160	13,070								
MISCELLANEOUS CONTRACTS				23	9								
THERMAL RESOURCES 1/													
Existing Thermal Plants				1,454	138								
Centralia #1 & #2				1,313	932								
Jim Bridger #1, #2, #3, & #4				2,000	1,349								
Colstrip #1 & #2				330	285								
Trojan				1,130	872								
WNP #2				1,100	751								
Colstrip #3 & #4				980	702								
Boardman				530	403								
WNP #1				1,250	596								
WNP #4				0	226								
Hanford Extension				0	540								
Added Thermal Requirement				982	589								
TOTAL THERMAL RESOURCES				11,069	7,383								
TOTAL IMPORTS				261	520								
ESTIMATED HYDRO MAINTENANCE				-358	-52								
TOTAL RESOURCES (HYDRO AND THERMAL)				43,155	20,930								
RESERVES 2/				-2,700	0								
RESOURCES AVAILABLE FOR LOAD				40,455	20,930								
ESTIMATED LOAD													
Pacific Northwest Area				33,744	20,930								
SURPLUS OR (DEFICIT)				6,711	0								
CRITICAL PERIOD													
Starts:				August 16, 1928			September 1943				September 16, 1936		
Ends:				February 1932			April 1945				April 15, 1937		
Length (Months):				42-1/2 Months			20 Months				7 Months		
Study Identification				83-41			83-42				83-13		

1/ Thermal energy capabilities are based on an annual plant factor of 60 percent the first full year of operation and 75 percent thereafter. These annual plant factors include deductions for energy reserves and scheduled maintenance.

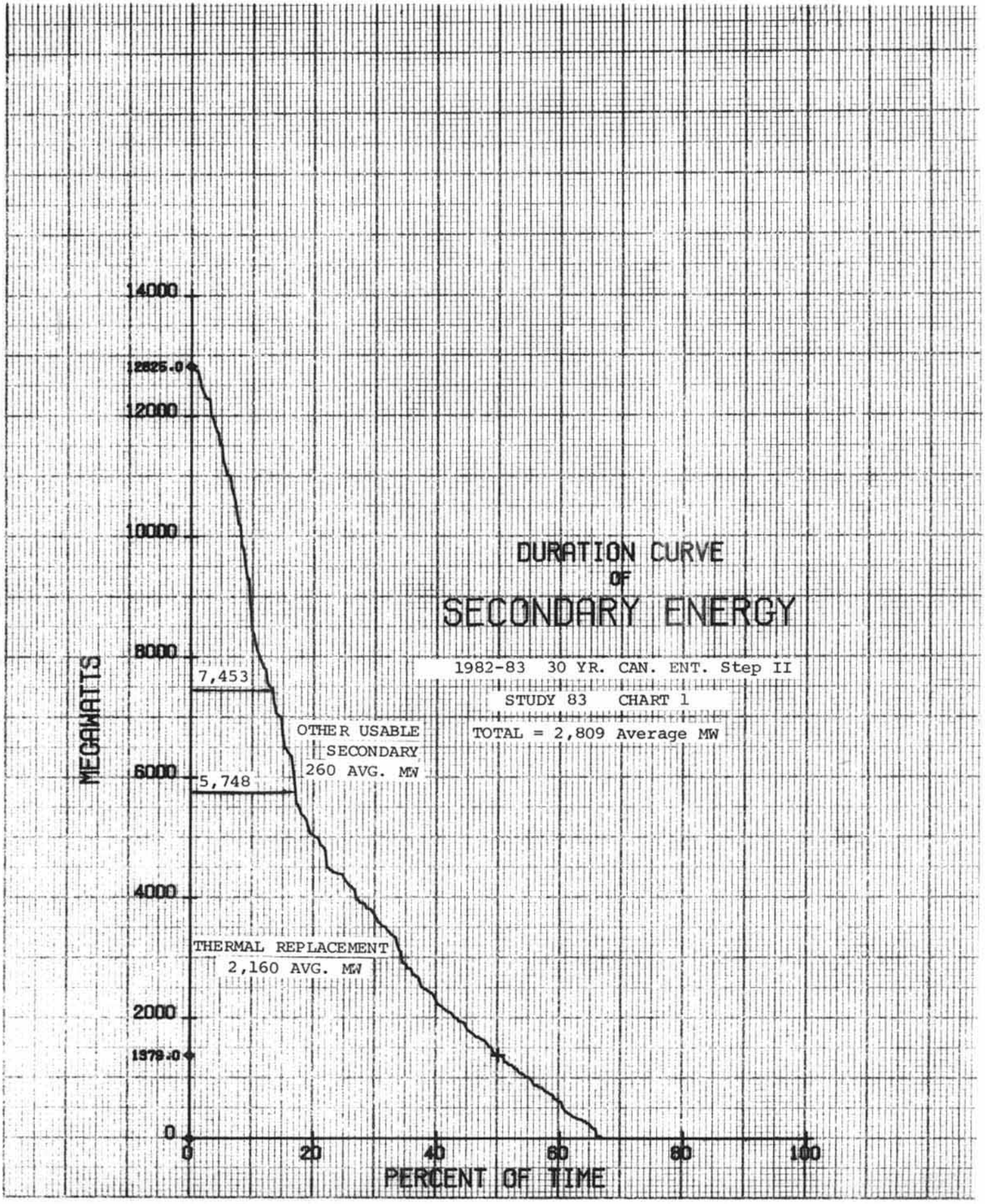
2/ Peak reserves are 8 percent of peak load; energy reserve deductions have been included in thermal plant energy capability.

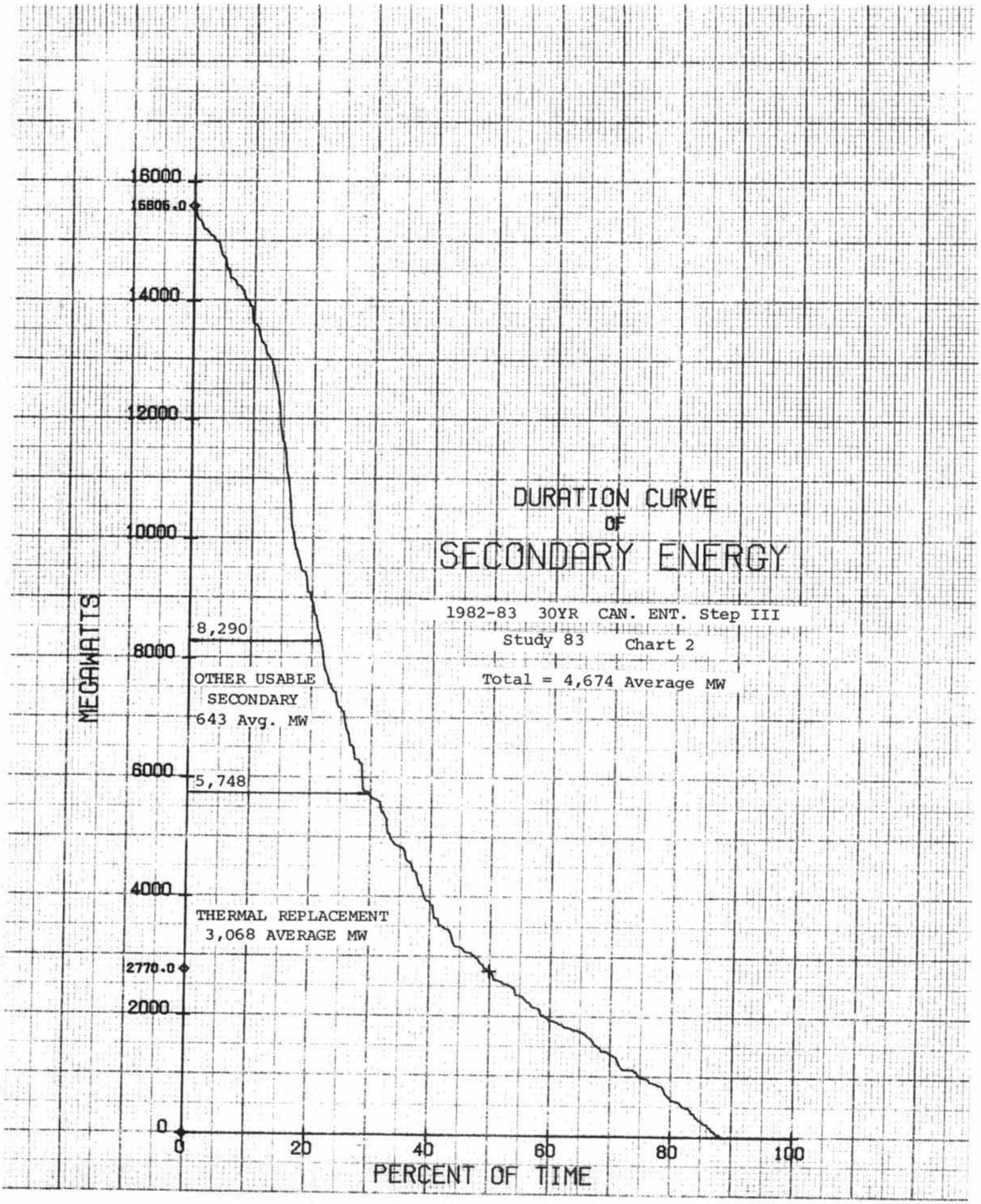
DETERMINATION OF LOAD SHAPE FOR STEP II AND III
1982-83 CANADIAN ENTITLEMENT COMPUTATIONS

	Pacific Northwest Area Load				Step II			Step III		
	Peak		Avg.	Load Factor %	Total Firm Load 1/	Thermal Firm Load	Hydro Firm Load	Total Firm Load 1/	Thermal Firm Load	Hydro Firm Load
Aug. 1-15	27,490	*	19,114	69.53	13,438	5,748	7,690	11,221	5,748	5,473
Aut. 16-31	27,399	*	19,053	69.54	13,395	5,748	7,647	11,186	5,748	5,438
Sept. 1-15	27,940	*	18,778	67.21	13,202	5,748	7,454	11,024	5,748	5,276
Sept. 16-30	27,895	*	18,740	67.18	13,175	5,748	7,427	11,002	5,748	5,254
October	29,594	*	19,684	66.51	13,839	5,748	8.091	11,556	5,748	5,808
November	30,866	*	21,635	70.09	15,210	5,748	9.462	12,702	5,748	6,954
December	33,283	*	23,433	70.41	16,474	5,748	10,726	13,757	5,748	8,009
January	33,744	*	24,026	71.20	16,891	5,748	11,143	14,105	5,748	8,357
February	31,877	*	22,753	71.38	15,996	5,748	10,248	13,358	5,748	7,610
March	30,305	*	21,529	71.04	15,136	5,748	9,388	12,639	5,748	6,891
Apr. 1-15	28,639	*	20,335	71.00	14,296	5,748	8,548	11,938	5,748	6,190
Apr. 16-30	28,640	*	20,336	71.01	14,297	5,748	8,549	11,939	5,748	6,191
May	28,653	*	19,579	68.33	13,765	5,748	8,017	11,494	5,748	5,746
June	28,533	*	19,655	68.89	13,818	5,748	8,070	11,539	5,748	5,791
July	27,995	*	19,538	69.79	13,736	5,748	7,988	11,470	5,748	5,722
Critical Period Avg.			20,930	69.581						
Annual Average			20,826							
January Peak	33,744	*								
Step I Critical Period Aug. 16, 1928 - Feb. 29, 1932 42-1/2 Months					Critical Period Sept. 1943 - Apr. 1945 20 Months			Critical Period Sept. 16, 1936-Apr. 15, 1937 7 Months		

1/ Total firm load of Step II andStep III systems, computed for each system to have an average energy load equivalent to the average energy capability within the critical period and to bear a constant ratio, month by month, to the Pacific Northwest Area Load.

* Figures so marked are peak megawatts. All other figures are monthly or semi-monthly energy in average megawatts.


DURATION CURVE
OF
SECONDARY ENERGY
1982-83 30 YR. CAN. ENT. Step II
STUDY 83 CHART 1
TOTAL = 2,809 Average MW
MEGAWATTS
14000
12825.0
12000
10000
8000
7,453
6000
5,748
4000
2000
1979.0
0
OTHER USABLE
SECONDARY
260 AVG. MW
THERMAL REPLACEMENT
2,160 AVG. MW
0
20
40
60
80
100
PERCENT OF TIME


DURATION CURVE
OF
SECONDARY ENERGY
1982-83 30YR CAN. ENT. Step III
Study 83 Chart 2
Total = 4,674 Average MW
MEGAWATTS
16000
15805.0
14000
12000
10000
8000
6000
4000
2770.0
2000
0
8,290
OTHER USABLE
SECONDARY
643 Avg. MW
5,748
THERMAL REPLACEMENT
3,068 AVERAGE MW
0
20
40
60
80
100
PERCENT OF TIME