COLUMBIA RIVER TREATY HYDROELECTRIC OPERATING PLAN

ASSURED OPERATING PLAN FOR OPERATING YEAR 1978-79

COLUMBIA RIVER TREATY OPERATING COMMITTEE / SEPTEMBER 1973

C O L U M B I A R I V E R T R E A T Y

AGREEMENT

on

HYDROELECTRIC OPERATING PLAN FOR TREATY STORAGES

OPERATING YEAR 1978-79

The Columbia River Treaty between the United States and Canada requires that hydroelectric operating plans be agreed in advance by the Entities for the operation of the storages provided in the Treaty. The Canadian Entity and the United States Entity herewith agree that the Treaty storages will be operated in accordance with the attached "Columbia River Treaty Operating Plan, Assured Operating Plan for Operating Year 1978-79," dated September 1973.

W. D. Kennedy
Chairman
Canadian Entity

Donald Paul Hodel
Chairman
United States Entity

September 28, 1973
Date of Agreement

COLUMBIA RIVER TREATY
HYDROELECTRIC OPERATING PLAN

Assured Operating Plan for
Operating Year 1978-79

TABLE OF CONTENTS

	Page
INTRODUCTION	1
SYSTEM REGULATION STUDIES	2
OPERATING RULE CURVES	3
OPERATING RULES	6
IMPLEMENTATION	10
REFERENCES	13

TABLES

1. Composite Critical Rule Curve
2. Composite Assured Refill Curve
3. Composite Variable Refill Curve
4. Duncan Flood Control Storage Reservation Curve
5. Arrow Flood Control Storage Reservation Curve
6. Mica Flood Control Storage Reservation Curve
7. Composite Operating Rule Curve

COLUMBIA RIVER TREATY
HYDROELECTRIC OPERATING PLAN

Assured Operating Plan for
Operating Year 1978-79

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 1978-79 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 1978-79.

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/], and Section B.1. of the Terms of Sale[4/]. The other operating criteria reflected in this plan is 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 Flood Control Storage Reservation 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 30-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 no reduction of the Canadian Entitlement of downstream power benefits.

System Regulation Studies for the Assured Operating Plan were based on 1978-79 estimated loads and resources in British Columbia and in the United States Pacific Northwest System. Historical flows for the period July 1928 through June 1958, modified to estimated 1978-79 conditions[7/], were used.

The Critical Rule Curve for these studies was determined from Bonneville Power Administration Study 79-41. The study indicated a 42-1/2 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 storage content at Mica is committed for power operation purposes under the Treaty, the studies are based on a full storage content of 20 million acre-feet to test compatibility with flood control parameters. Flood Control and Variable Refill Criteria are based on historical inflow volumes.

OPERATING RULE CURVES

The operation of Canadian storage during the 1978-79 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 dual projects. The Operating Rule Curve is derived from the various curves described below. These curves are first determined for the 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 as 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 April 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 less than 90 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 90 million acre-feet, the discharge used was that required to meet firm loads while refilling. In years when the runoff volume at The Dalles equaled or exceeded 90 million acre-feet the Power Discharge Requirement was the project minimum outflow. The following are the April through July Power Discharge Requirements used in computing the Variable Refill Curves:

	Power Discharge Requirements in c.f.s. For January through July Volume at The Dalles	
Project	Less Than 90 m.a.f.	Equal to or Greater Than 90 m.a.f.
Arrow	28,200	5,000
Duncan	2,300	100
Mica	18,300	3,000

Composite Variable Refill Curves for the whole of Canadian storage for the 30 years of historical record are recorded as Table 3. These illustrate the probable range of these curves based on historical conditions. In the actual operation in 1978-79, the Power Discharge Requirements will be based on the forecast of unregulated runoff at The Dalles.

(c) Flood Control Storage Reservation Curve. The Flood Control Storage Reservation Curves[8/] give end-of-month storage content to which each individual Canadian storage project shall be evacuated for flood control and other requirements during the Storage Evacuation Period. During the Flood Control Refill Period the flood control curves used in

in the studies were developed from daily system regulation studies. They reflect the use of historical inflow volumes. Flood control curves for the thirty-year study period are shown on Tables 4, 5, and 6. Tables 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. Prior to 1 January, 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; the Operating Rule Curve is the lower of the above-determined value or the Variable Refill Curve. Also, in all periods 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 30 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 1978-79 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 Year 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.

(d) Each project will be operated on or below the storage content defined by its Flood Control Storage Reservation 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 (4) below:

Mica Project Operating Criteria

Month	Target End-of-Period Storage Content (KSFD)	Target Average Outflow (CFS)	Minimum Outflow (CFS)	Maximum Outflow (CFS)
July	9990.2	-	10,000	-
August 1-15	9990.2	-	10,000	-
August 16-31	9990.2	-	10,000	-
September	9990.2	-	10,000	34,000
October	-	15,000	10,000	34,000
November	-	18,000	10,000	34,000
December	-	28,000	15,000	34,000
January	-	29,000	15,000	34,000
February	-	29,000	10,000	34,000
March	-	15,000	10,000	34,000
April 1-15	-	15,000	10,000	-
April 16-30	-	15,000	10,000	-
May	-	10,000	10,000	-
June	-	10,000	10,000	34,000

(1) Mica monthly outflows will be increased in the months from October to June if required to avoid violation of the Flood Control Storage Reservation Curve.

(2) Mica monthly average outflows will be increased in the months from July to March and the month of 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)
July	0 - 1000	34,000
	1001 - 2100	20,000
August	0 - 1000	30,000
	1001 - 2100	20,000
September	0 - 2000	20,000
October	0 - 1700	23,000
November	0 - 1500	31,000
December	0 - 1000	32,000
January	0 - 1000	32,000
February	0 - 1000	17,000
March	-	-
April	-	-
May	0 - 500	24,000
June	0 - 1000	34,000
	1001 - 2100	20,000

If the above table indicates the Mica outflow in August should be increased, the higher outflow applies in the first half only, and the second half of August will be examined using the August 15 Arrow content and the same criteria as for the first half.

(3) Unless an adjustment to the Mica target outflows during January, February, March, or June is required as specified in (2) above, Mica outflow will be reduced to minimum values to maintain the reservoir above the following storage content:

January	7900.0 KSFD
February	7560.6 KSFD
March	6994.6 KSFD
April	6779.0 KSFD
May	7298.2 KSFD
June	8656.9 KSFD

In this situation, the water remaining in Arrow will be sufficient to meet power draft requirements in the United States.

(4) Storage releases from Mica in excess of 7 million acre-feet may be made at the discretion of the Canadian Section of the Operating Committee, and these additional storage releases 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.

The operating rules set forth above are designed to produce optimum generation in Canada and in the United States, as required by Annex A of the Treaty in the situation where Mica dead storage has been filled. If this does not occur some modification of the rules may be necessary to ensure adequate and complete drafting of Canadian Treaty storage in Mica reservoir to meet United States power requirements. In that event, such modified rules will be included in the 1978-79 Detailed Operating Plan.

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 1978-79 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 1978 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 1978-79 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 1978-79 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 Sale — 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 30-Year System Regulation Study 79-41, dated 20 September 1973.

7/ Extension of Modified Flows through 1958, Water Management Subcommittee of CBIAC, dated June 1960.

8/ Summary of End-of-Month Reservoir Storage Requirement from Columbia River Flood Regulation Studies dated April 1973.

TABLE 1
COLUMBIA RIVER TREATY
COMPOSITE CRITICAL RULE CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1978-79 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
1ST YR	7814.6	7802.8	7592.3	7276.9	6901.1	5566.6	3462.3	1877.8	1850.1	797.8	2181.4	5611.0
2ND YR	6942.7	6842.3	6364.3	5615.8	4698.0	3421.4	1500.6	802.6	199.5	437.9	1579.6	3825.1
3RD YR	5654.7	5889.3	5763.3	5073.5	4395.7	2679.0	1183.4	332.7	96.1	0.0	777.7	2401.9
4TH YR	2983.7	2769.9	2620.5	2220.0	1668.5	470.7	95.0	0.0	0.0	0.0	0.0	0.0

TABLE 2
COLUMBIA RIVER TREATY
COMPOSITE ASSURED REFILL CURVE
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1978-79 OPERATING YEAR

JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
7.9	841.5	1533.6	1807.2	1964.0	2030.2	2087.7	2119.7	2218.5	1795.3	3100.7	5824.7	7814.6

TABLE 3
COLUMBIA RIVER TREATY
COMPOSITE VARIABLE REFILL CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1978-79 OPERATING YEAR

FLOW YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29							5885.3	6328.5	6250.6	5473.8	5753.0	7664.2	7814.6
1929-30							4085.5	3595.2	3593.4	3863.2	4657.6	6943.3	,,
1930-31							4876.1	4320.1	4277.9	3729.8	4932.1	7249.1	,,
1931-32							0.0	0.0	0.0	0.0	1485.8	5924.3	,,
1932-33							,,	,,	,,	,,	906.3	4814.3	,,
1933-34							,,	,,	,,	15.9	2724.4	6190.0	,,
1934-35							3235.4	2897.7	2937.4	2333.5	3071.7	5879.7	,,
1935-36							2850.0	2305.3	2234.8	2260.1	4861.5	7318.2	,,
1936-37							6968.8	6393.2	6313.0	5622.5	5916.3	7284.5	,,
1937-38							267.6	74.8	46.0	238.0	2323.2	6075.6	,,
1938-39							4313.1	3789.9	3786.6	3696.7	6037.7	7147.1	,,
1939-40							3517.1	3081.6	3191.7	3110.8	4894.4	7045.8	,,
1940-41							5593.5	5114.3	5222.3	5467.5	6349.7	7312.4	,,
1941-42							1528.2	1183.6	1141.0	1474.9	3235.2	5895.3	,,
1942-43							1956.9	1581.1	1515.1	2168.9	3395.4	5682.3	,,
1943-44							7317.2	7107.9	7044.4	6573.4	6775.6	7739.2	,,
1944-45							7167.7	6709.3	6565.9	5867.5	6518.4	7458.4	,,
1945-46							0.0	0.0	0.0	0.0	1954.7	5837.0	,,
1946-47							,,	,,	,,	,,	2336.5	5861.9	,,
1947-48							,,	,,	,,	,,	1918.2	6936.3	,,
1948-49							1769.8	1414.8	1379.4	1941.5	5175.3	7268.0	,,
1949-50							0.0	0.0	0.0	0.0	687.7	4867.0	,,
1950-51							,,	,,	,,	,,	2424.7	5266.9	,,
1951-52							313.9	116.2	76.1	463.7	2841.5	5162.4	,,
1952-53							996.6	665.9	645.1	806.9	2676.3	5941.4	,,
1953-54							0.0	0.0	0.0	0.0	583.3	4144.7	,,
1954-55							255.5	107.2	93.2	99.8	970.3	4885.6	,,
1955-56							0.0	0.0	0.0	0.0	2119.6	5944.5	,,
1956-57							,,	,,	,,	,,	3132.7	6970.3	,,
1957-58							1524.5	1237.5	1318.8	1763.9	5837.1	7814.6	,,

TABLE 4

FLOOD CONTROL STORAGE RESERVATION CURVES

DUNCAN

KSFO

1978-79 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	679.1	679.1	679.1	679.1	679.1	477.4	370.5	276.3	276.3	297.9	389.7	533.9	679.1
1929-30	,,	,,	,,	,,	,,	,,	359.0	254.6	254.6	277.3	374.1	526.3	,,
1930-31	,,	,,	,,	,,	,,	,,	341.8	221.3	221.3	246.0	350.4	514.2	,,
1931-32	,,	,,	,,	,,	,,	,,	245.5	38.8	38.8	82.2	254.6	582.8	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	67.5	164.8	546.5	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	100.3	313.1	578.8	,,
1934-35	,,	,,	,,	,,	,,	,,	,,	,,	,,	57.0	160.3	461.3	,,
1935-36	,,	,,	,,	,,	,,	,,	,,	,,	,,	92.8	325.2	679.1	,,
1936-37	,,	,,	,,	,,	,,	,,	327.2	193.1	193.1	219.3	330.2	504.2	,,
1937-38	,,	,,	,,	,,	,,	,,	245.5	38.8	38.8	57.0	190.6	515.7	,,
1938-39	,,	,,	,,	,,	,,	,,	,,	,,	,,	80.7	359.0	679.1	,,
1939-40	,,	,,	,,	,,	,,	,,	,,	,,	,,	77.1	,,	,,	,,
1940-41	,,	,,	,,	,,	,,	,,	294.4	129.6	129.6	159.3	284.3	481.5	,,
1941-42	,,	,,	,,	,,	,,	,,	275.3	94.3	94.3	128.5	265.2	456.3	,,
1942-43	,,	,,	,,	,,	,,	,,	278.3	99.3	99.3	146.2	221.3	621.1	,,
1943-44	,,	,,	,,	,,	,,	,,	366.0	267.7	267.7	289.9	383.7	530.9	,,
1944-45	,,	,,	,,	,,	,,	,,	334.8	207.7	207.7	210.2	323.2	541.0	,,
1945-46	,,	,,	,,	,,	,,	,,	245.5	38.8	38.8	69.1	295.4	620.6	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	75.1	287.4	603.0	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	38.8	273.7	679.1	,,
1948-49	,,	,,	,,	,,	,,	,,	321.6	182.0	182.0	210.2	382.1	,,	,,
1949-50	,,	,,	,,	,,	,,	,,	245.5	38.8	38.8	58.0	157.3	498.6	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	76.6	258.6	507.7	,,
1951-52	,,	,,	,,	,,	,,	,,	,,	,,	,,	40.8	65.5	228.4	,,
1952-53	,,	,,	,,	,,	,,	,,	,,	,,	,,	58.0	207.7	496.1	,,
1953-54	,,	,,	,,	,,	,,	,,	,,	,,	,,	57.5	210.2	520.8	,,
1954-55	,,	,,	,,	,,	,,	,,	,,	,,	,,	53.9	128.0	461.8	,,
1955-56	,,	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	213.2	551.5	,,
1956-57	,,	,,	,,	,,	,,	,,	,,	38.8	38.8	63.0	349.4	629.2	,,
1957-58	,,	,,	,,	,,	,,	,,	,,	,,	,,	69.6	332.7	679.1	,,

TABLE 5
FLOOD CONTROL STORAGE RESERVATION CURVES
ARROW
KSFO
1978-79 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	3602.3	3602.3	3602.3	3476.3	3476.3	3098.1	3098.1	3098.1	3098.1	3133.9	3258.5	3602.3	3602.3
1929-30	,,	,,	,,	,,	,,	,,	3083.5	3070.4	3055.8	3094.6	3229.7	,,	,,
1930-31	,,	,,	,,	,,	,,	,,	3098.1	3098.1	3098.1	3133.9	3258.5	,,	,,
1931-32	,,	,,	,,	,,	,,	,,	2387.3	1741.9	1031.0	1149.5	2247.1	,,	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	1059.3	1784.3	3057.3	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	1807.5	2349.9	3602.3	,,
1934-35	,,	,,	,,	,,	,,	,,	,,	,,	,,	1031.0	1748.5	3057.3	,,
1935-36	,,	,,	,,	,,	,,	,,	,,	,,	,,	1396.1	2157.4	3602.3	,,
1936-37	,,	,,	,,	,,	,,	,,	3021.0	2950.4	2873.3	2925.2	3105.2	,,	,,
1937-38	,,	,,	,,	,,	,,	,,	2387.3	1741.9	1031.0	1300.8	1853.8	3170.2	,,
1938-39	,,	,,	,,	,,	,,	,,	2660.5	2266.3	1828.5	2006.1	2757.8	3602.3	,,
1939-40	,,	,,	,,	,,	,,	,,	2872.3	2668.1	2442.7	2558.7	3022.5	,,	,,
1940-41	,,	,,	,,	,,	,,	,,	3098.1	3098.1	3098.1	3133.9	3258.5	,,	,,
1941-42	,,	,,	,,	,,	,,	,,	2387.3	1741.9	1031.0	1172.2	1955.7	,,	,,
1942-43	,,	,,	,,	,,	,,	,,	,,	,,	,,	1344.6	1463.1	2412.0	,,
1943-44	,,	,,	,,	,,	,,	,,	3098.1	3098.1	3098.1	3133.9	3258.5	3602.3	,,
1944-45	,,	,,	,,	,,	,,	,,	2664.5	2274.3	1840.7	1931.0	2499.7	3391.1	,,
1945-46	,,	,,	,,	,,	,,	,,	2387.3	1741.9	1031.0	1265.0	2223.9	3602.3	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	1383.5	2170.0	,,	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	1206.0	2239.5	,,	,,
1948-49	,,	,,	,,	,,	,,	,,	,,	,,	,,	1398.6	2517.3	,,	,,
1949-50	,,	,,	,,	,,	,,	,,	,,	,,	,,	1136.4	1136.4	2255.2	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	1123.8	1377.9	3360.8	,,
1951-52	,,	,,	,,	,,	,,	,,	,,	,,	,,	1367.8	1815.0	3036.6	,,
1952-53	,,	,,	,,	,,	,,	,,	,,	,,	,,	1195.4	1498.9	,,	,,
1953-54	,,	,,	,,	,,	,,	,,	,,	,,	,,	1157.1	1650.7	1920.9	,,
1954-55	,,	,,	,,	,,	,,	,,	,,	,,	,,	1113.2	1676.4	3247.4	,,
1955-56	,,	,,	,,	,,	,,	,,	,,	879.8	22.7	312.6	1390.0	2786.1	,,
1956-57	,,	,,	,,	,,	,,	,,	,,	1741.9	1031.0	1246.8	2674.1	3602.3	,,
1957-58	,,	,,	,,	,,	,,	,,	,,	,,	,,	1213.5	2265.2	,,	,,

TABLE 6
FLOOD CONTROL STORAGE RESERVATION CURVES
MICA
KSFO
1978-79 OPERATING YEAR

	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	3533.2	3533.2	3533.2	3432.4	3432.4	3432.4	3410.7	3391.0	3369.3	3384.5	3415.2	3473.7	3533.2
1929-30	,,	,,	,,	,,	,,	,,	3382.5	3336.6	3296.7	3309.9	3357.2	3444.0	,,
1930-31	,,	,,	,,	,,	,,	,,	3432.4	3432.4	3432.4	3441.9	3461.1	3496.9	,,
1931-32	,,	,,	,,	,,	,,	,,	3104.7	2812.2	2484.5	2581.8	2785.5	3153.6	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1934-35	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1935-36	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1936-37	,,	,,	,,	,,	,,	,,	3357.2	3287.7	3212.5	3242.3	3304.8	3417.2	,,
1937-38	,,	,,	,,	,,	,,	,,	3104.7	2812.2	2484.5	2581.8	2785.5	3153.6	,,
1938-39	,,	,,	,,	,,	,,	,,	3217.1	3022.5	2810.7	2877.8	3017.9	3271.5	,,
1939-40	,,	,,	,,	,,	,,	,,	3300.8	3178.3	3046.7	3092.1	3186.3	3357.2	,,
1940-41	,,	,,	,,	,,	,,	,,	3432.4	3432.4	3432.4	3441.9	3461.1	3496.9	,,
1941-42	,,	,,	,,	,,	,,	,,	3104.7	2812.2	2484.5	2581.8	2785.5	3153.6	,,
1942-43	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1943-44	,,	,,	,,	,,	,,	,,	3432.4	3432.4	3432.4	3441.9	3461.1	3496.9	,,
1944-45	,,	,,	,,	,,	,,	,,	3218.6	3025.5	2815.3	2882.3	3021.5	3273.6	,,
1945-46	,,	,,	,,	,,	,,	,,	3104.7	2812.2	2484.5	2581.8	2785.5	3153.6	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1948-49	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1949-50	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1951-52	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1952-53	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1953-54	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1954-55	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1955-56	,,	,,	,,	,,	,,	,,	2071.1	1062.8	104.9	104.9	807.7	2367.6	,,
1956-57	,,	,,	,,	,,	,,	,,	3104.7	2812.2	2484.5	2581.8	2785.5	3153.6	,,
1957-58	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,

TABLE 7
COLUMBIA RIVER TREATY
COMPOSITE OPERATING RULE CURVES
FOR THE WHOLE OF CANADIAN STORAGE
END OF MONTH CONTENTS IN KSFD
1978-79 OPERATING YEAR

FLOW YEAR	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
1928-29	7814.6	7802.8	7592.3	7276.6	6901.1	5566.6	3606.9	2429.3	2852.8	1795.3	3158.7	6257.5	7814.6
1929-30	,,	,,	,,	,,	,,	,,	3411.7	,,	,,	,,	,,	,,	,,
1930-31	,,	,,	,,	,,	,,	,,	3606.9	,,	,,	,,	,,	,,	,,
1931-32	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	1485.8	5854.0	,,
1932-33	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	906.3	4814.3	,,
1933-34	,,	,,	,,	,,	,,	,,	,,	,,	,,	15.9	2579.9	6132.1	,,
1934-35	,,	,,	,,	,,	,,	,,	2832.0	2399.6	2656.7	1733.5	3042.0	5868.3	,,
1935-36	,,	,,	,,	,,	,,	,,	2532.0	2125.9	2385.6	1697.9	3145.4	6257.5	,,
1936-37	,,	,,	,,	,,	,,	,,	3606.9	2429.3	2852.8	1795.3	3158.7	,,	,,
1937-38	,,	,,	,,	,,	,,	,,	267.6	74.8	46.1	238.0	2323.2	6043.5	,,
1938-39	,,	,,	,,	,,	,,	,,	3606.9	2429.3	2838.2	1795.3	3158.7	6257.5	,,
1939-40	,,	,,	,,	,,	,,	,,	3149.5	,,	2844.1	,,	,,	,,	,,
1940-41	,,	,,	,,	,,	,,	,,	3606.9	,,	2852.8	,,	,,	,,	,,
1941-42	,,	,,	,,	,,	,,	,,	1528.2	1183.6	1141.0	1031.5	2885.5	5895.3	,,
1942-43	,,	,,	,,	,,	,,	,,	1956.9	1317.2	1515.1	1410.1	3006.2	5682.3	,,
1943-44	,,	,,	,,	,,	,,	,,	3606.9	2429.3	2852.8	1795.3	3158.7	6257.5	,,
1944-45	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
1945-46	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	1954.7	5837.0	,,
1946-47	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	2324.0	5861.8	,,
1947-48	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	1918.2	6257.5	,,
1948-49	,,	,,	,,	,,	,,	,,	1769.8	1414.8	1379.4	1702.6	3158.7	,,	,,
1949-50	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	687.7	4867.0	,,
1950-51	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	2292.5	5266.9	,,
1951-52	,,	,,	,,	,,	,,	,,	313.9	116.2	76.1	463.7	2806.2	6051.8	,,
1952-53	,,	,,	,,	,,	,,	,,	996.6	665.9	645.1	806.9	2666.2	5886.6	,,
1953-54	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	583.3	4144.7	,,
1954-55	,,	,,	,,	,,	,,	,,	255.5	107.2	93.2	99.8	970.3	4885.6	,,
1955-56	,,	,,	,,	,,	,,	,,	0.0	0.0	0.0	0.0	2119.6	5925.9	,,
1956-57	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	3041.1	6257.5	,,
1957-58	,,	,,	,,	,,	,,	,,	1524.5	1237.5	1318.8	1659.1	3158.7	,,	,,

COLUMBIA RIVER TREATY

AGREEMENT

on

DETERMINATION OF DOWNSTREAM POWER BENEFITS RESULTING FROM CANADIAN STORAGE FOR OPERATING YEAR 1978-79

The Columbia River Treaty between Canada and the United States requires that the downstream power benefits resulting from operating plans agreed to by the Entities will be determined in advance by the Entities. The determination of downstream power benefits for the operating year 1978-79 is covered in the attached report, dated September 1973, and is agreed to by the United States Entity and the Canadian Entity.

W. D. Kennedy
Chairman
Canadian Entity

Donald Paul Hodel
Chairman
United States Entity

September 28, 1973
Date of Agreement

DETERMINATION OF DOWNSTREAM POWER BENEFITS RESULTING FROM CANADIAN STORAGE
FOR OPERATING YEAR 1978-79
September 1973

I. 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 requires 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, 1978-79, and for the storages 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 September 9, 1968.

The Canadian Entitlement Benefits were computed as follows:

Step I - based on the total U.S. planned hydro and thermal system with $15\frac{1}{2}$ maf of Canadian storage operated for optimum generation in both countries (79-41 study).

Step II - based on the U.S. base hydro and thermal system with $15\frac{1}{2}$ maf of Canadian storage operated for optimum generation in both countries (79-42 study).

Step III - based on the U.S. base hydro and thermal system operated for optimum generation in U.S. (79-13 study).

In addition to the determination of downstream power benefits for the operating year 1978-79, 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 = 1,454.5 mw

Average Annual Energy = 683.5 mw

(b) One-half of the minimum permitted downstream power benefits computed in accordance with paragraph 4 of the document dated 15 November 1971 determined for 15 maf of Canadian storage operated for optimum generation in the United States:

Dependable Capacity = 1,430.5 mw

Average Annual Energy = 661.5 mw

Whenever one-half the downstream power benefits equal or exceed the above established minimum, they are within permitted range. Therefore, since one-half the established 1978-79 downstream power benefits exceed this, they fall within the specified range.

III. Effect on Canadian Entitlement

The Canadian Entitlement to downstream power benefits was sold in the United States of America under the Canadian Entitlement Purchase Agreement dated 13 August 1964. By definition, the Canadian Entitlement for 1978-79 which was sold was that which would have been computed if the 1978-79 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 = $\frac{1}{2}$ of 2,909 mw or 1,454.5 mw

Average Annual Energy = $\frac{1}{2}$ of 1,366 mw or 683.0 mw

Since the 1978-79 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 1978-79 Assured Operating Plan was determined as:

Dependable Capacity = $\frac{1}{2}$ of 2,909 mw or 1,454.5 mw

Average Annual Energy = $\frac{1}{2}$ of 1,367 mw or 683.5 mw

The comparison indicates no significant differences between the two measurements and therefore there is no reduction of the Canadian Entitlement.

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 0.98674 and 0.95652, respectively);

(4) Pro rate the average annual Step II or 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 hydro load. The average annual hydro load for Steps II and III also becomes 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% 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 capability and the estimated secondary load.

Thermal Energy Capability - mw	5,549
Less 5% Reserve - mw	277
Less Minimum Thermal Generation	1,335
Thermal Replacement - mw	3,937

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

	Step II	Step III
Thermal Replacement	3,937	3,937
Other	1,488	2,487
Total - mw	5,425	6,424

TABLE 1

COMPUTATION OF CANADIAN ENTITLEMENT

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

Determination of Dependable Capacity Credited to Canadian Storage

Critical Period Average Rate of Generation with Canadian Storage, Step II	9,041
Critical Period Average Rate of Generation without Canadian Storage, Step III.	7,036
Gain Due to Canadian Storage	2,005
Estimated Average Critical Period Load Factor — Percent	68.916
Dependable Capacity Gain[1/]	2,909
Canadian Share of Dependable Capacity	1,454.5

Determination of Increase in Average Annual Usable Energy

Step II (with Canadian Storage)

Annual Firm Hydro Energy	8,869
Thermal Replacement Energy	1,803
Other Usable Secondary Energy	305
System Annual Average Usable Energy	10,977

Step III (without Canadian Storage)

Annual Firm Hydro Energy	6,559
Thermal Replacement Energy	2,321
Other Usable Secondary Energy	730
System Annual Average Usable Energy	9,610

Average Annual Usable Energy Gain	1,367
Canadian Share of Average Annual Energy Gain	683.5

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 1976-79
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			7,008			7,008							
Arrow			7,145			7,145							
Duncan			1,347			1,347							
Subtotal			15,500			15,500							
BASE FEDERAL SYSTEM													
Hungry Horse	4	328	3,161	162	101	3,008	250	116	104	3,008	278	213	102
Albeni Falls	3	49	1,155	22	24	1,155	21	22	22	1,155	23	25	25
Grand Coulee	22-23+2	5,538	5,232	5,162	2,003	5,072	5,503	1,772	2,335	5,072	5,201	1,226	2,215
Chief Joseph	23-27	2,309		2,309	1,091		2,309	1,003	1,327		2,309	708	1,239
Ice Harbor	6	693		693	219		693	224	304		693	171	304
McNary	14	1,127		1,127	648		1,127	594	766		1,127	430	715
John Day	16	2,484	535	2,484	918		2,484	927	1,273		2,484	680	1,233
The Dalles	22	2,018		2,018	817		2,018	795	1,044		2,018	618	1,019
Bonneville	10	574		574	553		574	547	552		574	457	533
Subtotal		15,120	10,083	14,551	6,374	9,235	14,979	6,000	7,727	9,235	14,707	4,528	7,385
BASE SYSTEM NON-FEDERAL													
Kootenay Lake (Canadian)			787			427				427			
Kerr	3	185	1,219	173	114	1,219	173	103	122	1,219	179	151	122
Thompson Falls	6	40		40	36		38	37	32		38	36	31
Noxon Rapids	4	430	231	394	173		430	160	218		430	179	219
Cabinet Gorge	4	230		230	112		230	99	129		230	111	129
Box Canyon	4	71		70	46		70	44	48		71	51	48
Coeur d'Alene & Long Lake			327			223				223			
Wells	10	842		842	438		842	410	518		842	288	476
Chelan	2	54	677	50	38	676	51	38	46	676	52	49	45
Rocky Reach	11	1,291		1,291	645		1,291	606	772		1,291	427	718
Rock Island	10	159		155	155		156	155	149		158	124	140
Wanapum	10	986		986	560		986	525	665		986	366	600
Priest Rapids	10	912		912	528		912	497	625		912	357	566
Brownlee	4	450	980	450	225	974	450	256	268	974	450	254	261
Oxbow	4	220		220	94		220	111	118		220	115	118
Subtotal		5,870	4,221	5,813	3,164	3,519	5,849	3,041	3,710	3,519	5,859	2,508	3,473
TOTAL BASE SYSTEM HYDRO		20,990	29,804	20,364	9,538	28,254	20,828	9,041	11,437	12,754	20,566	7,036	10,858
ADDITIONAL STEP I PROJECTS													
Libby	4	483	4,934	211	191								
Boundary	4	650		650	361								
Spokane River Plants		153		147	89								
Hells Canyon	3	450		450	178								
Dworshak	3	460	2,015	417	161								
Lower Granite	3-6	466		466	220								
Little Goose	3-6	466		466	216								
Lower Monumental	3	466		466	217								
Pelton and Round Butte		454	274	423	132								
Subtotal		4,048	7,223	3,696	1,765								
Independent Resources		4,650	8,489	3,720	1,714								
TOTAL HYDRO RESOURCES		29,688	45,516	27,780	13,017								
MISCELLANEOUS CONTRACTS				38	11								
THERMAL RESOURCES													
Existing Thermal Plants				1,397	218								
Centralia #1 & #2				1,400	1,260								
Trojan				1,130	1,017								
Jim Bridger #1, #2, & #3				1,500	1,350								
Colstrip #1 & #2				350	315								
Hanford #2				1,100	990								
Colstrip #3 & #4				525	399								
TOTAL THERMAL RESOURCES				7,402	5,549								
TOTAL IMPORTS				-	457								
TOTAL RESOURCES (HYDRO AND THERMAL)				35,220	19,034								
RESERVES 1/				-2,369	-277								
RESOURCES AVAILABLE FOR LOAD				32,851	18,757								
ESTIMATED LOAD													
Pacific Northwest Area				29,607	18,158								
SURPLUS OR (DEFICIT)				3,244	599								
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			79-41			79-42				79-13			

1/ Peak reserves are 8% of peak load; energy reserves are 5% of thermal plant energy capability.

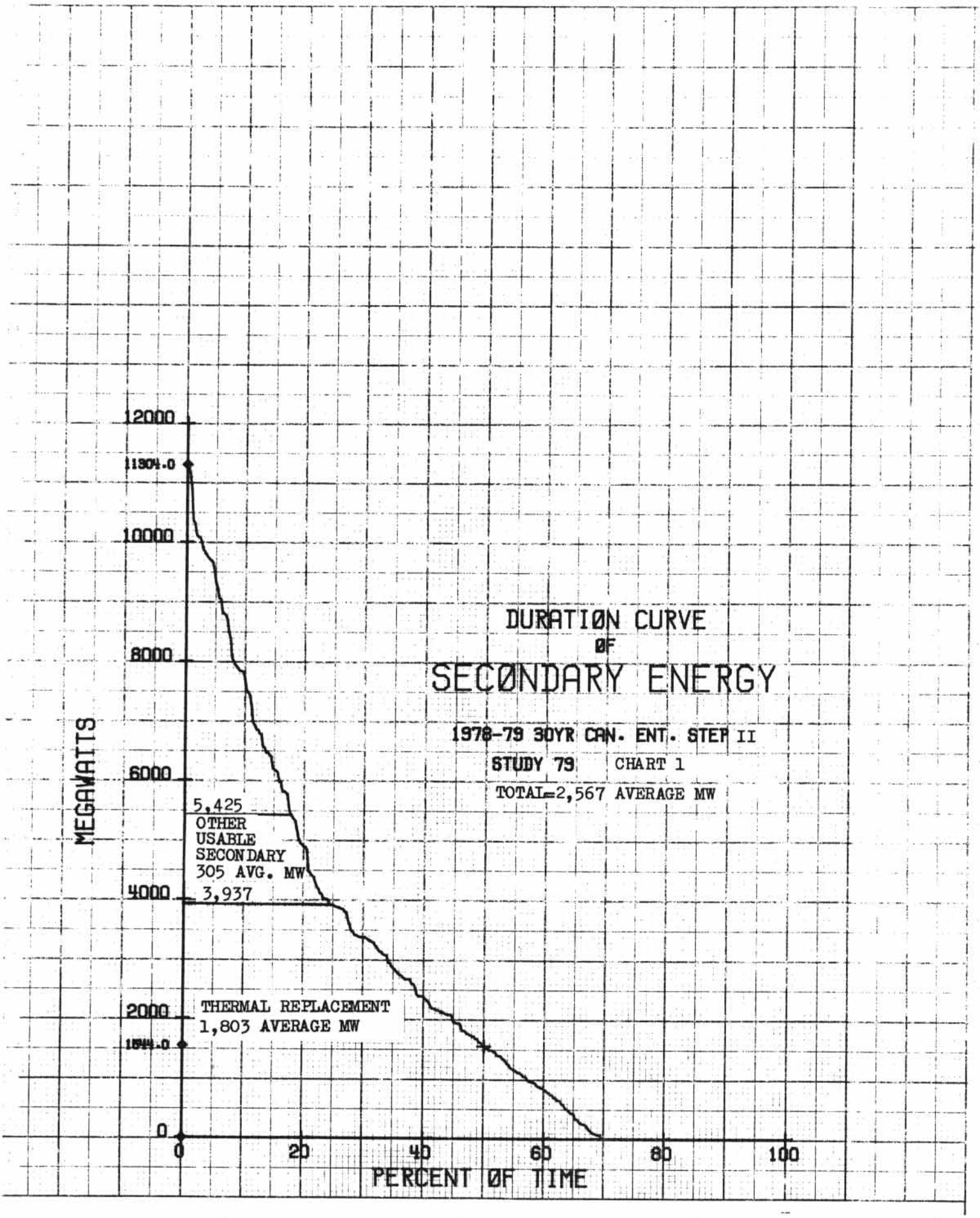
DETERMINATION OF LOAD SHAPE FOR STEP II AND III
1978-79 CANADIAN ENTITLEMENT COMPUTATIONS

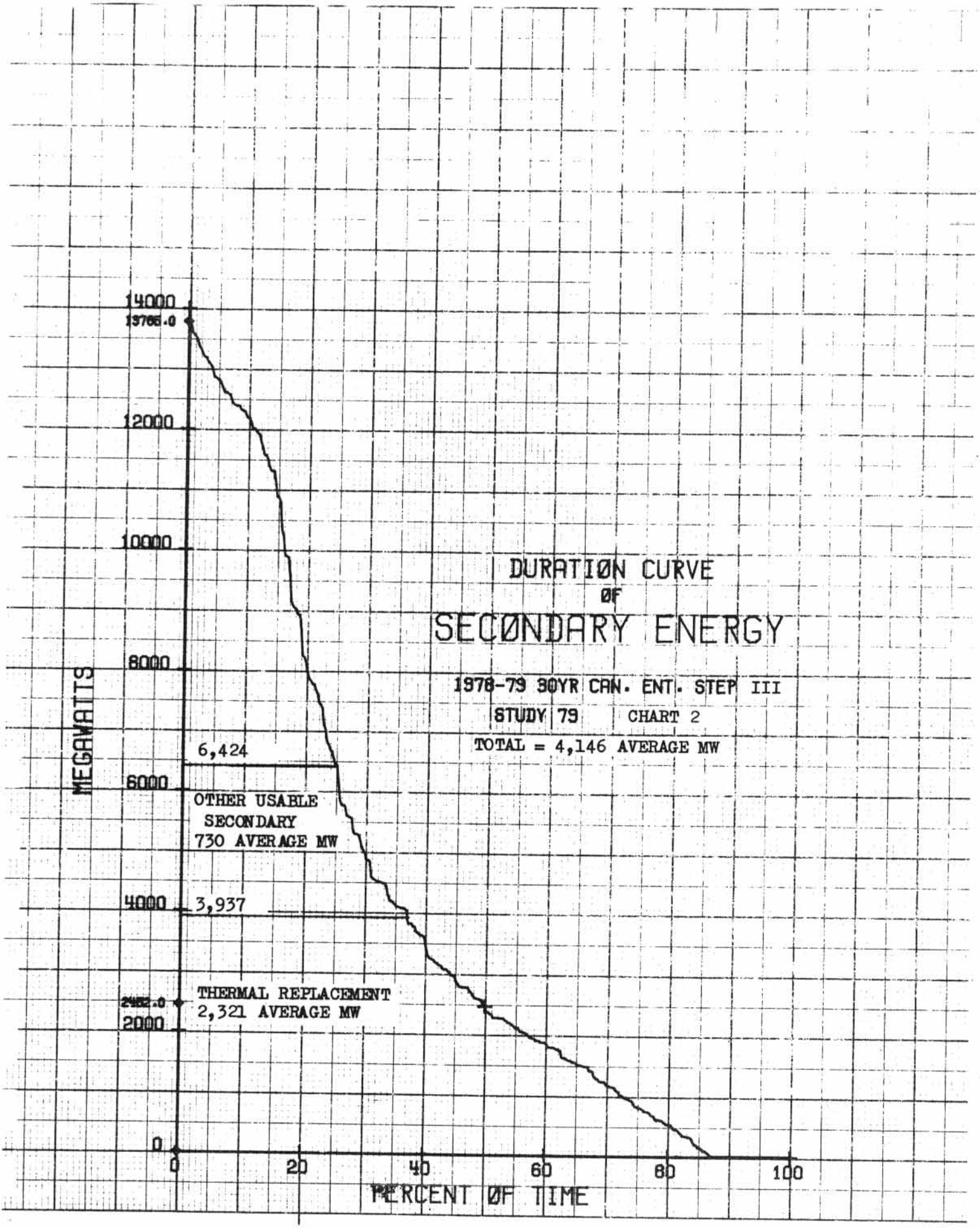
	Pacific Northwest Area Load			Step II			Step III		
	Peak	Avg.	Load Factor %	Total Firm Load 1/	Thermal Firm Load	Hydro Firm Load	Total Firm Load 1/	Thermal Firm Load	Hydro Firm Load
July	23,799 *	16,490	69.29	11,684	3,937	7,747	9,577	3,937	5,640
Aug. 1-15	24,286 *	16,642	68.53	11,792	3,937	7,855	9,665	3,937	5,728
Aug. 16-31	24,209 *	16,545	68.34	11,723	3,937	7,786	9,609	3,937	5,672
Sept. 1-15	24,401 *	16,401	67.21	11,621	3,937	7,684	9,525	3,937	5,588
Sept. 16-30	24,355 *	16,365	67.19	11,596	3,937	7,659	9,504	3,937	5,567
October	26,047 *	17,246	66.21	12,220	3,937	8,283	10,016	3,937	6,079
November	26,787 *	18,600	69.44	13,180	3,937	9,243	10,802	3,937	6,865
December	29,430 *	20,085	68.25	14,232	3,937	10,295	11,664	3,937	7,727
January	29,607 *	20,771	70.16	14,718	3,937	10,781	12,063	3,937	8,126
February	27,613 *	19,760	71.56	14,001	3,937	10,064	11,476	3,937	7,539
March	26,490 *	18,728	70.70	13,270	3,937	9,333	10,876	3,937	6,939
Apr. 1-15	25,182 *	17,803	70.70	12,615	3,937	8,678	10,339	3,937	6,402
Apr. 16-30	25,191 *	17,863	70.91	12,657	3,937	8,720	10,374	3,937	6,437
May	25,533 *	17,294	67.73	12,254	3,937	8,317	10,044	3,937	6,107
June	25,327 *	17,178	67.83	12,172	3,937	8,235	9,976	3,937	6,039
Critical Period Avg.		18,158	68.916	12,978	3,937	9,041	10,973	3,937	7,036
Annual Average		18,073		12,806	3,937	8,869	10,496	3,937	6,559
January Peak	29,607 *								
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 and Step 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.

TABLE 3


DURATIØN CURVE
ØF
SECØNDARY ENERGY
1978-79 30YR CAN. ENT. STEP II
STUDY 79 CHART 1
TOTAL=2,567 AVERAGE MW
MEGAWATTS
12000
11304.0
10000
8000
6000
5,425
OTHER
USABLE
SECONDARY
305 AVG. MW
4000
3,937
2000
THERMAL REPLACEMENT
1,803 AVERAGE MW
1544.0
0
0
20
40
60
80
100
PERCENT ØF TIME


DURATIØN CURVE
ØF
SECØNDARY ENERGY
1978-79 30YR CAN. ENT. STEP III
STUDY 79 CHART 2
TOTAL = 4,146 AVERAGE MW
MEGAWATTS
14000
13765.0
12000
10000
8000
6,424
6000
OTHER USABLE
SECONDARY
730 AVERAGE MW
4000
3,937
2462.0
2000
THERMAL REPLACEMENT
2,321 AVERAGE MW
0
0
20
40
60
80
100
PERCENT ØF TIME