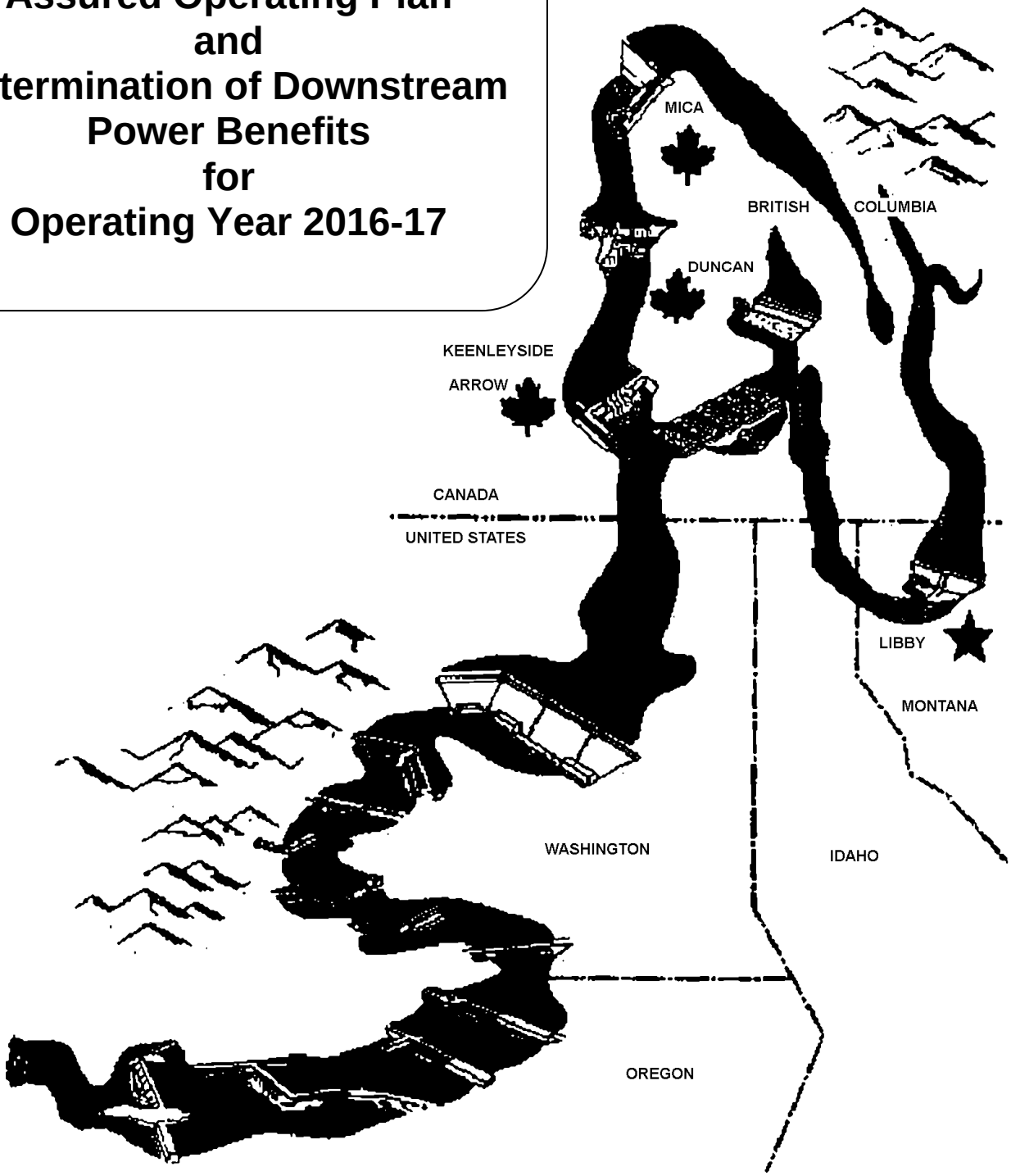
COLUMBIA RIVER TREATY
Assured Operating Plan
and
Determination of Downstream Power Benefits
for
Operating Year 2016-17



Columbia River Treaty Operating Committee

November 2011

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COLUMBIA RIVER TREATY ENTITY AGREEMENT ON THE ASSURED OPERATING PLAN AND DETERMINATION OF DOWNSTREAM POWER BENEFITS FOR OPERATING YEAR 2016-17

The Columbia River Treaty between Canada and the United States of America requires that the Entities agree annually on an assured plan of operation for Canadian Treaty Storage and the resulting downstream power benefits for the sixth succeeding year.

The Entities agree that the attached reports entitled "Columbia River Treaty Hydroelectric Operating Plan: Assured Operating Plan for Operating Year 2016-17" and "Columbia River Treaty Determination of Downstream Power Benefits for the Assured Operating Plan for Operating Year 2016-17," both dated November 2011, shall be the Assured Operating Plan and Determination of Downstream Power Benefits for the 2016-17 Operating Year.

In witness thereof, the Entities have caused this Agreement to be executed.

Executed for the Canadian Entity this 5th day of January, 2012.

By: _____
Charles Reid
Chairman

Executed for the United States Entity this 9th day of December, 2011.

By: _____
Stephen J. Wright
Chairman

By: _____
Brigadier General John R. McMahon
Member

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COLUMBIA RIVER TREATY
HYDROELECTRIC OPERATING PLAN

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HYDROELECTRIC OPERATING PLAN
ASSURED OPERATING PLAN
FOR OPERATING YEAR 2016-17

November 2011

1. 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" (Treaty), dated 17 January 1961, requires that each year the Entities designated by the two governments will formulate and carry out operating arrangements necessary to implement the Treaty and will agree on an Assured Operating Plan (AOP) for the Treaty storage in Canada (Canadian Treaty Storage) and resulting downstream power benefits for the sixth succeeding operating year. This AOP for operating year 2016-17 (AOP17) provides the Entities with an operating plan for Canadian Treaty Storage and information for planning the power systems that are dependent on or coordinated with the operation of the Canadian Treaty Storage projects.

2. Development of the Assured Operating Plan

a) Procedures

This AOP was prepared in accordance with the Treaty, the "Protocol - Annex to Exchange of Notes, Dated January 22, 1964 Between the Governments of Canada and the United States Regarding the Columbia River Treaty" (Protocol), and the following Entity Agreements:

- The Entity Agreements, signed 28 July and 12 August 1988, on "Principles for the Preparation of the AOP and Determination of Downstream Power Benefit (DDPB) Studies" and "Changes to Procedures for the Preparation of the AOP and DDPB Studies" (1988 Entity Agreements);

- The "Columbia River Treaty Entity Agreement on Resolving the Dispute on Critical Period Determination, the Capacity Entitlement, for the 1998-99, 1999-00, and 2000-01 AOP/DDPBs, and Operating Procedures for the 2001-02 and Future AOPs," signed 29 August 1996 (29 August 1996 Entity Agreement); and

- Except for the changes noted below, the "Columbia River Treaty Entity Agreement on the Principles and Procedures for Preparing and Implementing Hydroelectric Operating Plans For Operation of Canadian Treaty Storage" (POP), dated October 2003 and signed 16 December 2003, including the September 2011 update to Appendix 1 - Refill Curves, the November 2004 additions of Appendix 6 - Streamline Procedures, and Appendix 7 - Table of Median Stream

flows, and the September 2007 addition of Appendix 8 concerning Water Supply Forecasts.

Special terms used in this document, but not defined herein, have the meanings defined in the Treaty, Protocol, or the above Entity Agreements. The POP is based on criteria contained in Annex A and Annex B of the Treaty, the Protocol, and the May 2003 Columbia River Treaty Flood Control Operating Plan (FCOP).

For this AOP, the Entities have agreed to use the first and second of the three streamline procedures defined in Appendix 6 of the POP. These streamline procedures include "Forecasting Loads and Resources" for determining the thermal installations, as described in Subsection 7(d) of this document, and the "Multi-Year Use of Same Operating Criteria for Canadian Treaty Storage" based on the AOP16 Joint Optimum Step I system regulation study, as explained in subsection 2(b).

In addition, the Entities have agreed to add to or modify certain procedures defined in POP as follows:

- Include an import from Canada equal to 50% of the estimated Canadian Entitlement to serve PNWA load;

- Allocate available uncommitted PNWA resources and available uncommitted imports from Canada and California to balance the White Book (WB) firm load/resource deficit, as was done since the AOP/DDPB13 and described in Subsection 7(b). For the AOP17, seasonal exchanges were not added to help balance WB loads and resources (as was done in AOP15, but not AOP16), but seasonal exchanges were added as needed to make the coordinated hydro load shape the same as the AOP16, as described in Subsection 2(b);

- Adjust thermal installation maintenance schedules as in AOP16 and described in Subsection 7(d);

- Shape generic thermal installations based on the full amount of WB large thermal, co-generation and combustion turbines and 30% of unreported CT energy capability that are estimated to be needed to meet the WB load, as described in Subsection 7(d); and

In accordance with Protocol VII(2), this AOP provides a reservoir-balance relationship for each month for the whole of the Canadian Treaty Storage. This relationship is determined from the following:

- The Critical Rule Curves (CRCs), Upper Rule Curves (URCs), and the related rule curves and data for each project used to compute the individual project Operating Rule Curves (ORCs);

- Operating rules and criteria for operation of the Canadian Treaty Storage in accordance with the principles contained in the above references; and

- The supporting data and model used to simulate the 30-year operation for the Step I Joint Optimum (AOP16-41) system regulation study[1].

This AOP includes both metric (International Standard) and English units[2]. The system regulation studies and supporting data were based on English units. The metric units are approximations derived by rounding conversions from English units. Metric values are displayed with either one or two decimal places to assure consistency with English units and do not imply that level of precision. The inclusion of metric units complies with USA Federal statutory requirements. Tables referred to in the text are in English units. Metric tables use the same numbering system with the letter "M" after the table number.

b) System Regulation Studies

This AOP was prepared in accordance with Annex A, paragraph 7, of the Treaty, which requires Canadian Treaty Storage operation for joint optimum power generation in both Canada and the USA. Downstream power benefits were computed with the Canadian Treaty Storage operation based on the same criteria for joint optimum power generation as in the Step I study.

Step I system regulation studies for the AOP17 are based on 2016-17 operating year estimated loads and resources in the USA PNWA including estimated flows of power from and to adjacent areas and hydro resources in the Columbia River Basin in British Columbia. In accordance with the Streamline Procedure "Multi-Year Use of Same Operating Criteria for Canadian Treaty Storage", the Entities have agreed to add seasonal exchange imports and exports to adjust the Step I system regulated hydro load to be the same as the AOP16. With the same regulated hydro load and no change in hydro system capability, the AOP16 Step I system regulation study can serve as the basis for the AOP17..

In accordance with Protocol VIII, the AOP17 is based on a 30-year stream flow period and the Entities have agreed to use an operating year of 1 August to 31 July. The studies used historical flows for the period August 1928 through July 1958, modified by estimated irrigation depletions for the 2000 level[3] and including updated estimates of Grand Coulee pumping requirements.

The CRCs were determined from a critical period study of optimum power generation in both Canada and the USA. The study indicated a 42.5 calendar-month critical period for the USA system resulting from the low flows during the period from 16 August 1928 through 29 February 1932. With the exception of Brownlee and Dworshak, it was assumed that all reservoirs, both in the USA and Canada, were full at the beginning of the critical period except where minimum release requirements made this impossible.

The flood control operation at Canadian projects was based on individual project flood control criteria instead of a composite curve. The Canadian Entity selected a 5.03/4.44 cubic kilometer (km^3) (4.08/3.6 million acre-feet (Maf)) Mica/Arrow flood control allocation in accordance with Section 6 of the FCOP. Flood Control and Variable Refill Curves are based on historical inflow volumes. Although only 19.12 km^3 (15.5 Maf) of usable storage are committed for power operation purposes under the Treaty, the FCOP provides for the full draft of the total 25.29 km^3 (20.5 Maf) of usable storage for on-call flood control purposes. Flood Control Rule Curves are implemented in the system regulation studies as URCs.

c) Evaluation of the Joint Optimum Study

In accordance with Subsections 3.2.A and 3.3.A(3) of the POP, the changes in Canadian Treaty Storage operation for an optimum power generation at-site in Canada and downstream in Canada and the USA (Joint Optimum), compared to an operation for optimum power only in the USA (USA Optimum), were evaluated as required by Annex A, paragraph 7, of the Treaty using the two criteria described below.

(1) Determination of Optimum Generation in Canada and the USA

To determine whether optimum power generation in both Canada and the USA was achieved in the system regulation studies, the annual firm energy capability, dependable peaking capability, and average annual usable secondary energy were computed for both the Canadian and USA systems. The Canadian Treaty Storage operation in the Joint Optimum Study was designed to achieve a weighted sum of these three quantities that was greater than the weighted sum achieved in the USA Optimum Study.

In order to measure optimum power generation for the AOP17, the Columbia River Treaty Operating Committee agreed that the three quantities would be assigned the following relative values:

Quantity	Relative Value
Annual firm energy capability (average megawatts (aMW))	3
Dependable peaking capability (MW)	1
Average annual usable secondary energy (aMW)	2

The sum of the three weighted quantities showed a net gain in the Joint Optimum Study compared to the USA Optimum Study. The Entities agree that this result is in accordance with Subsection 3.2.A of the POP. The results of these calculations are shown in Table 2.

(2) Maximum Permitted Reduction in Downstream Power Benefits

Annex A, paragraph 7 of the Treaty defines the limits to any reduction in the downstream power benefits in the USA resulting from a change in operation to achieve a joint optimum operation. The Step II system regulation study was developed which reflects the Canadian Treaty Storage operation with optimum generation in the USA only. The Canadian Entitlement, which was calculated using this USA optimum study, was adjusted by a 3.7 aMW increase in the average annual usable energy. This adjustment estimates the impact that would occur if a reoperation study was run in order to develop a joint optimum operation, as observed in the AOP/DDPB16. No adjustment was made to the dependable capacity. (See Table 5 of DDPB17.)

Since there is no reduction in entitlement, the Entities have determined in Section 4 of the DDPB17 that the calculation of maximum permitted reduction in downstream power benefits is not necessary.

3. Rule Curves

The operation of Canadian Treaty Storage during the 2016-17 Operating Year shall be guided by the ORCs and CRCs for the whole of Canadian Treaty Storage, Flood Control Curves for the individual projects, and project operating criteria for Mica and Arrow. The ORCs and CRCs are first determined for the individual Canadian projects and then summed to yield the Composite ORC for the whole of Canadian Treaty Storage, in accordance with paragraph VII (2) of the Protocol. The ORCs are derived from the various curves described below.

a) Critical Rule Curves

The CRC is defined by the end-of-period storage content of Canadian Treaty Storage during the critical period. It is used to determine proportional draft below the ORCs as defined in Subsection 4(b). Generally, CRCs are adjusted for crossovers by the hydro regulation model as defined in Section 2.3.A of the POP. CRC crossovers occur when the second, third, or fourth year CRCs are higher than any of the lower numbered CRCs, and past practice was for the hydro regulation model to lower the storage amounts in the higher numbered CRCs at all projects as needed to eliminate the crossover. For the Canadian Treaty projects, this adjustment is applied only if the sum of Mica + Arrow + Duncan Treaty storage has a composite CRC crossover. The adjustment is made to Arrow first unless or until Arrow is empty, then the adjustment is made to Duncan. The CRCs for Duncan, Arrow, Mica, and the Composite CRCs for the whole of Canadian Treaty Storage are tabulated in Table 3.

b) Refill Curves

There are two types of refill curves, Assured Refill Curves (ARCs) and Variable Refill Curves (VRCs), which are discussed in the following subsections. Tabulations of the ARCs and VRCs, and supporting data used in determining the ARCs and VRCs for Mica, Arrow, and Duncan are provided in Tables 4, 5, and 6, respectively.

(1) Assured Refill Curves

The ARCs indicate the minimum August through June end-of-period storage contents required to meet firm load and refill the Coordinated System storage by 31 July, based on the 1930-31 inflows. The upstream storage requirements and the Power Discharge Requirements (PDR) are determined in accordance with Section 2.3.B and Appendix 1 of the POP, and revisions defined in Subsection 2(a) and discussed in Subsection 7(f) of this document. The 1930-31 inflows are the second lowest January through July unregulated stream flows at The Dalles, Oregon, during the 30-year (1928-58) stream flow period, which has approximately a 95% probability of exceedance.

(2) Variable Refill Curves

The VRCs indicate the minimum January through June end-of-period storage contents required to refill the Coordinated System storage by 31 July based on the 95% confidence forecasted inflow volume. The upstream storage refill requirements and PDRs are determined in accordance with Section 2.3.B and Appendix 1 of the POP. In the system regulation studies, historical volume inflows, adjusted for the 95% confidence forecast error, were used instead of forecast inflows. The PDRs are a function of the unregulated January through July runoff volume at The Dalles, Oregon. In those years when the January through July runoff volume at The Dalles is between 98.68 km^3 (80 Maf) and 135.69 km^3 (110 Maf), the PDRs are interpolated linearly between the values shown in Tables 4-6. In those years when the January through July runoff volume at The Dalles is less than 98.68 km^3 (80 Maf), or greater than 135.69 km^3 (110 Maf), the PDR values for 98.68 km^3 and 135.69 km^3 (80 Maf and 110 Maf), respectively, are used. For AOP17, as in the AOP12 through AOP16, the VRC Lower Limit (VRCLL) was applied as a fixed rule curve for Grand Coulee only.

Tables 4-6 illustrate the range of VRCs for Mica, Arrow, and Duncan for the 30-year stream flow period. In actual operation in 2016-17, the PDRs and VRCLLs will be based on the forecast of unregulated runoff at The Dalles.

c) Operating Rule Curve Lower Limits (ORCLLs)

The ORCLLs indicate the minimum 31 January through 15 April end-of-period storage contents that must be maintained to protect the ability of the system to meet firm load during the period 1 January through 30 April. The ORCLLs protect the system's ability to meet firm load in the event that the VRCs permit storage to be emptied and sufficient natural flow is not available to carry the load prior to the start of the freshet. Such rule curves shall limit the ORC to be no lower than the ORCLLs. The ORCLLs are developed for 1936-37 water conditions which include the lowest January through April unregulated stream flows at The Dalles during the 30-year stream flow period. The ORCLLs for Mica, Arrow, and Duncan are shown in Tables 4, 5, and 6 respectively.

d) Upper Rule Curves (Flood Control)

The URCs indicate the end-of-period storage content to which each individual Canadian Treaty Storage project shall be evacuated for flood control. The URCs used in the studies were based upon Flood Control Storage Reservation Diagrams contained in the FCOP and analysis of system flood control simulations. URCs for Mica, Arrow, and Duncan for the 30-year stream flow period are shown in Tables 7, 8, and 9 respectively. Tables 7 and 8 reflect an agreed transfer of flood control space in Mica and Arrow to maximum drafts of 5.03 km^3 and 4.44 km^3 (4.08 Maf and 3.6 Maf) respectively. In actual operation, the URCs will be computed as outlined in the FCOP using the latest forecast of runoff available at that time.

e) Operating Rule Curves

The ORCs define the normal limit of storage draft to produce secondary energy and provide a high probability of refilling the reservoirs. In general, the Operating Plan does not permit serving secondary loads at the risk of failing to refill storage and thereby jeopardizing the firm load carrying capability of the USA or Canadian systems during subsequent years.

During the period 1 August through 31 December, the ORC is defined as the CRC for the first year of the critical period (CRC1) or the ARC, whichever is higher. During the period 1 January through 31 July, the ORC is defined as the higher of the CRC1 and the ARC, unless the VRC (limited by the VRCLL) is lower, then the VRC defines the ORC. During the period 1 January through 15 April, the ORC will not be lower than the ORCLL. The ORC shall be less than or equal to the URC at each individual project. The composite ORCs for the whole of Canadian Treaty Storage for the 30-year stream flow period are included in Table 10 to illustrate the probable future range of these curves based on historical water conditions.

4. Operating Rules

As described in Subsection 2(b), the AOP17 system regulation study is based on the AOP16-41 system regulation study. The storage operation results for the whole of Canadian Treaty Storage for the 30-year stream flow period are shown in Table 11. The study contains the agreed-upon ORCs and CRCs, and operating procedures and constraints, such as maximum and minimum project elevations, discharges, and draft rates. These constraints are included as part of this operating plan and are listed in Appendix A.

The following rules and other operating criteria included in the AOP16-41 system regulation study will apply to the operation of Canadian Treaty Storage in the 2016-17 Operating Year, subject to the provisions under Section 5.

a) Operation at or above ORC

The whole of Canadian Treaty Storage will be drafted to its ORC as required to produce optimum generation in Canada and the USA in accordance with Annex A, paragraph 7, of the Treaty, subject to project physical characteristics and operating constraints.

b) Operation below ORC

The whole of Canadian Treaty Storage will be drafted below its ORC as required to produce optimum power generation, to the extent that a system regulation study determines that proportional draft below the ORC is required to produce the hydro firm energy load carrying capability (FELCC) of the USA system. FELCC is determined by the applicable Critical Period regulation study. Proportional draft between rule curves will be determined as described in Section 2.4.C of the POP.

c) Canadian Treaty Project Operating Criteria

Mica and Arrow reservoirs will be operated in accordance with project operating criteria listed in Tables 1 and 1.1, respectively, so as to optimize generation at Mica, Revelstoke, and Arrow, and downstream in the USA. Under these operating criteria, outflows will be increased as required to avoid storage above the URC at each reservoir.

(1) Mica Project Operating Criteria

In general, the Mica operation in each period is either a target flow or target content, as listed in Table 1 and determined by Arrow's storage content at the end of the previous period. In the event that Mica's operation to the Table 1 operating criteria results in more or less than the project's share of draft from the whole of Canadian Treaty Storage as described in Subsections 4(a) or 4(b) above, compensating changes will be made from Arrow to the extent possible.

Mica storage releases in excess of 8.63 km^3 (7.0 Maf) that are required to maintain the Mica outflows specified under this plan will be retained in the Arrow reservoir, subject to flood control and other project operating criteria at Arrow. The total combined storage draft from Mica and Arrow will not exceed 17.39 km^3 (14.1 Maf), unless flood control or minimum flow criteria will not permit the excess Mica storage releases to be retained at Arrow. Based on this AOP, the probability of a combined Mica + Arrow storage release in excess of 17.39 km^3 (14.1 Maf) occurring has been judged to be negligible; however, in actual operations, should Treaty specified constraints require combined Mica + Arrow storage draft in excess of 17.39 km^3 (14.1 Maf), it is mutually agreed for the sole purpose of this AOP that such releases may occur. If such a release should occur, the target Mica operation will remain as specified in Table 1, and the excess release will be returned as soon as the operating criteria permit.

The adoption of the above described procedure for addressing total combined storage draft from Mica and Arrow in this AOP17 is not intended to set a precedent for future AOPs and is subject to change in future AOPs.

(2) Arrow Project Operating Criteria (APOC)

In general, Arrow reservoir will be operated to provide the balance of the required Canadian Treaty Storage as described in Subsections 4(a) or 4(b) above, subject to physical and operating constraints. These constraints include, but are not limited to, the URC, rate-of-draft and minimum flows limits, and the Arrow Project Operating Criteria (APOC).

The APOC is shown in Table 1.1(a) and consists of maximum storage limits, maximum outflow limits and minimum outflow limits at Arrow. The maximum storage limits apply from February to June depending on the forecast for The Dalles residual unregulated runoff for the current month through July. The maximum and minimum outflow limits apply under all water conditions, subject to flood control requirements and a maximum combined draft of 17.39 km^3 (14.1 Maf) at Mica + Arrow, respectively. In no circumstance shall the

minimum outflow be reduced below the Treaty specified minimum of 142 m^3/s (5,000 cfs).

The implementation of the APOC storage limits in the Detailed Operating Plan will use the distribution factors shown in Table 1.1(c). These distribution factors are multiplied by the current month through July forecast volumes at The Dalles, to calculate future month through July volume forecasts. The resulting residual month-July volumes are then used to determine the maximum storage levels from the criteria provided in Table 1.1(a). To assist implementation of this procedure, an example is shown at the bottom of Table 1.1(c).

d) Other Canadian Project Operation

Revelstoke, Upper Bonnington, Lower Bonnington, South Slocan, Brilliant, Seven Mile, and Waneta are included in the AOP16 as run-of-river projects. Generation at Arrow is modeled in the studies. Corra Linn and Kootenay Canal are included and operated in accordance with criteria utilized in prior AOPs.

5. Preparation of the Detailed Operating Plan

The Entities have to this date agreed that each year a Detailed Operating Plan (DOP) will be prepared for the immediately succeeding operating year. Such DOPs are made under authority of Article XIV.2 of the Columbia River Treaty, which states in part:

". . . 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 2016-17 DOP (DOP17) will reflect the latest available load, resource, and other pertinent data to the extent the Entities agree that this data should be included in the plan. The data and criteria contained herein may be reviewed and updated as agreed by the Entities to form the basis for a DOP17. Failing agreement on updating the data and/or criteria, the DOP17 for Canadian Treaty Storage shall include the rule curves, Mica and Arrow operating criteria, and other data and criteria provided in this AOP. Actual operation of Canadian Treaty Storage during the 2016 -17 Operating Year shall be guided by the DOP17.

The values used in the AOP studies to define the various rule curves were period-end values only. In actual operation, it is necessary to operate in such a manner during the course of each period that these period-end values can be achieved in accordance with the operating rules. Due to the normal variation of power load and stream flow during any period, straight-line interpolation between the period-end points should not be assumed. During the storage drawdown season, Canadian Treaty Storage should not be drafted below its period-end point at any time during the period 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-period value as required.

During the storage evacuation and refill season, operation will be consistent with the FCOP. When refill of Canadian Treaty Storage is being guided by Flood Control Refill Curves, 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, unless higher flows are required to meet firm load, for each day through the end of the refill season.

6. Canadian Entitlement

The amount of Canadian Entitlement is defined in the companion document "Determination of Downstream Power Benefits for the Assured Operating Plan for Operating Year 2016-17."

The Treaty specifies return of the Canadian Entitlement at a point near Oliver, British Columbia, unless otherwise agreed by the Entities. Because no cross-border transmission exists near Oliver, the Entities completed an agreement on Aspects of the Delivery of the Canadian Entitlement for 1 April 1998 through 15 September 2024, dated 29 March 1999[4]. This arrangement covers the full 1 August 2016 through 31 July 2017 period covered by this AOP, and includes transmission losses and scheduling guidelines for delivery of the Canadian Entitlement.

7. Summary of Changes Compared to the 2015-16 AOP and Notable Assumptions

Data from the recent AOPs are compared and summarized in Table 12. An explanation of the more important changes and notable assumptions follows.

a) Pacific Northwest Area (PNWA) Firm Load

Loads for the AOP17 are based on Bonneville Power Administration's (BPA) April 2010 White Book (WB10)[5] expected load forecast. The WB10 forecast for the 2016-17 regional firm load is 23,283 annual aMW, which is 326 aMW (1.4%) higher than the AOP16. As there were only minor changes to the Idaho portion of the Utah Power & Light load and to the Coulee pumping requirements, the net PNWA firm load also increased by 324 annual aMW (1.4%) from the AOP16 to AOP17.

The average critical period load factor increased from 73.93% in AOP16 to 74.03% in AOP17. This was mainly due to changes in the load forecast.

b) Flows of Power at Points of Interconnection

The Step I System Load includes the net effect of flows of power at points of interconnection which are all imports and exports, except those classified as thermal installations, plant sales, and flow-through-transfers.

- For the AOP16 and AOP17, the estimate of the amount of Canadian Entitlement energy and other uncommitted imports that would be assumed to serve load in the PNWA were based on a similar procedure being used since AOP13, except that the use of added seasonal exchanges to balance firm WB loads and

resources has been eliminated. This procedure assumes all of the Canadian Entitlement is returned to Canada, but is then available as an uncommitted import for the PNWA. The procedure determines the WB10 firm energy deficit without uncommitted thermal resources and then uses a two-step pro rata approach to allocate uncommitted PNWA resources (including unreported combustion turbine (CT) capability) and available uncommitted imports from Canada and California to eliminate deficits. The first step reduces or eliminates the monthly deficits using available uncommitted PNWA resources (without unreported CT capability) and available Canadian imports. For the AOP17, the Entities had agreed that 50% (235 annual aMW) of the estimated Canadian Entitlement would be used as a Canadian import for serving PNWA load, with the uncommitted PNWA resources (without unreported CT capability) being allocated next to reduce or eliminate the monthly deficits. Any remaining deficits are then allocated based on the proportion of available unreported CT capability and assumed available California imports. The resulting amount of allocated imports are included in the Step I load/resource balance. Compared to AOP16, this procedure results in a 29 annual aMW decrease in Entitlement energy serving load in the U.S.

- The estimated Canadian Entitlement included in export loads was 470 average annual MW of energy and 1332 MW of capacity. The amount computed for the DDPB17 is 484.0 average annual MW of energy and 1333.2 MW of capacity. Iterative studies to update the Canadian Entitlement assumed in the load estimate (see DDPB Table 1) were not performed because the effect on the amount of thermal installations would not affect the results of the studies in a noticeable manner.
- For the AOP17, as with the AOP15 and AOP16, a seasonal exchange to reshape the residual hydro load to reflect differences between AOP and WB hydro capabilities was not used. In addition, the AOP17 did not use seasonal exchanges to balance the firm WB loads and resources. However, in accordance with the Streamline Procedure “Multi-Year Use of Same Operating Criteria for Canadian Treaty Storage” and as described in Subsection 2(b), a small seasonal exchange was added to the AOP17 to adjust the Step I system regulated hydro load to be the same as the AOP16.
- Compared to the AOP16, power flows-out (exports that are mostly to the southwest but also include the Entitlement) increased by 10 annual aMW, and power flows-in (imports) increased by 21 annual aMW. These differences are primarily due to changes in WB imports, WB exports and seasonal exchanges.

c) Non-Step I Hydro and Other Non-Thermal Resources

The Step I System Load is reduced by hydro independent generation, non-Step I coordinated hydro, and miscellaneous non-thermal resources. For the AOP17, these resources have decreased by 9 annual aMW over the AOP16. This is primarily due to an increase in export of wind generation in AOP17.

d) Thermal Installations

Because of increasing difficulty in forecasting Thermal Installations, the Entities again used the Streamline Procedure for “Loads and Resources” for determining

Thermal Installations, as used since AOP07. The procedure includes the Columbia Generating Station (CGS, formerly called Washington Public Power Supply System #2 nuclear power plant) plus one generic Thermal Installation, sized as needed to balance loads and resources in the critical period. In this AOP, an average of the two year (2015-16 and 2016-17) maintenance cycle at CGS was used, which resulted in the same annual average generation for AOP16 and AOP17.

For the AOP17, as in the AOP16, it was agreed that the coordinated thermal installations used to determine the shape of the generic thermal installation for the AOP load and resource balance are the full amount of WB10 large thermal, co-generation, and combustion turbines and 30% of unreported CT energy capability that are estimated to be needed to meet the WB10 load.

The total thermal installations increased by 332 annual aMW from AOP16 to AOP17 due to a combination of all changes in loads and resources as explained above.

e) Hydro Project Modified Stream flows

The unregulated base stream flows for the Step I system regulation studies were the same as the AOP16 studies, which were based on the 2000 Level Modified Stream flows with updates provided for Grand Coulee pumping from the PNCA 1 February 2010 data submittal.

f) Hydro Project Rule Curves

In accordance with the Streamline Procedure "Multi-Year Use of Same Operating Criteria for Canadian Treaty Storage", and as described in Subsection 2(b), the AOP17 system regulation studies use the same hydro project rule curves as the AOP16. Some notable assumptions include:

- The use of a fixed VRCLL at Grand Coulee only, equal to the ORCLL for January and February, and based on historic minimum elevations for firm power operation for March to June (373.4 m (1225.0 ft) for March to April, 378.0 m (1240.0 ft) for May, and 391.7 m (1285.0 ft) for June);

- The agreed allocation of flood control space in Mica and Arrow is 5.03 and 4.44 km^3 (4.08 and 3.6 Maf), respectively;

- The use of the AOP16, 30-year URC data developed by the Corps of Engineers;

- For the AOP16 Critical Period Study, the March ARC contents at Grand Coulee are 5732.6 hm^3 (2343.1 ksfd) and 5593.9 hm^3 (2286.4 ksfd) for Steps I and II, respectively. These March ARC storage limits were based on the average of the AOP11, 12 and 15 ARCs from the ARC optimization study, and limited by flood control. Up to the AOP15, the March ARCs were calculated using the final ARCs from the previous AOP study. However, from AOP11 to AOP15, this procedure resulted in significant year-to-year reductions in the March ARC contents at Grand Coulee, which may potentially reduce system firm and secondary energy. The revised procedure for AOP16 was intended to avoid this impact; and

- The use of the AOP16 Refill Curves. The PDRs developed during the AOP16 Refill Study for all steps started with minimum flows and were increased as needed to pass the Refill Test.

g) Other Hydro Project Operating Procedures, Constraints, and Plant Data

In accordance with the Streamline Procedure "Multi-Year Use of Same Operating Criteria for Canadian Treaty Storage", and as described in Subsection 2(b), the AOP17 hydro project operating procedures, constraints and plant data are the same as in the AOP16.

The AOP16 hydro project operating procedures, constraints and plant data were updated from the PNCA 1 February 2010 data submittal in accordance with POP procedures, except as noted below.

The nonpower requirements for Base System projects were agreed to in the 29 August 1996 Entity Agreement. These requirements are essentially the nonpower requirements included in the 1979-80 and prior AOP/DDPB studies. Nonpower constraints for non-Base System projects are updated to current requirements, except for Libby, which uses the values specified in the February 2000 Libby Coordination Agreement. Some notable assumptions include:

- Brownlee minimum flow requirements are 166 m^3/s (5,850 cfs), in all periods plus the flow needed to reach 368 m^3/s (13,000 cfs) at Lime Point during July through September;

- Dworshak is operated to a minimum flow or flood control October through May, and a target operation June through September to obtain uniform outflows July through August;

- Grand Coulee, which is normally drafted 0.61 m (2 ft) at the beginning of the critical period, is held full through August 31, 1928 to avoid a surplus;

- Hungry Horse is operated to a maximum flow of 269.0 m^3/s (9500 cfs) to reflect transmission constraints with Libby;

- The 30-year storage operation at Mossyrock, Cushman 1, Alder, Swift #1, Merwin, Yale, and Timothy was set to a fixed operation (first coded) from the 2006 AOP because they are no longer coordinated resources in PNCA Planning. Although included in the AOP16 Step I hydro regulation model, these projects are now essentially the same as a hydro-independent project;

- Ross and Gorge operating data were updated to the PNCA 1 February, 2010 data submittal; and

- Hydro-independent projects are updated for the 2000 Modified Flows.

[1] "BPA Hydroelectric Power Planning Program, Assured Operating Plan 30-year System Regulation Study 16-41," dated 14 July, 2011.

[2] The conversion factors used are:
(a) million acre-feet (Maf) times 1.2335 equals cubic kilometers (km^3);
(b) thousand second-foot-days (ksfd) times 2.4466 equals cubic hectometers (hm^3);
(c) cubic feet per second (cfs) divided by 35.3147 equals cubic meters per second (m^3/s); and
(d) feet (ft) times 0.3048 equals meters (m).

[3] "Report on 2000 Level Modified Streamflow, 1928 to 1999, Columbia River and Costal Basins," prepared by BPA, dated May 2004.

[4] "Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for April 1, 1998 Through September 15, 2024" between the Canadian Entity and the United States Entity, dated 29 March 1999.

[5] October 2010 Final Study #67 of the "2010 Pacific Northwest Loads & Resources Study, Operating Years 2010 through 2019".

TABLE 1
(English Units)
MICA PROJECT OPERATING CRITERIA
2016-17 ASSURED OPERATING PLAN

		Target Operation		Target Operation Limits		
Month	End of Previous Month **Arrow** Storage Content (ksfd)	Month Average Outflow (cfs)	End-of-Month Treaty Storage Content 1/ (ksfd)	Minimum Treaty Storage Content 2/ (ksfd)	Maximum Outflow 1/ (cfs)	Minimum Outflow (cfs)
August 1-15	3,300 - FULL	-	3,379.2	-	34,000	15,000
	2,150 - 3,300	25,000	-	0	-	15,000
	0 - 2,150	32,000	-	0	-	15,000
August 16-31	3,500 - FULL	-	3,529.2	-	34,000	15,000
	2,150 - 3,500	25,000	-	0	-	15,000
	0 - 2,150	32,000	-	0	-	15,000
September	3,530 - FULL	-	3,529.2	-	34,000	10,000
	3,500 - 3,530	25,000	-	0	-	10,000
	2,100 - 3,500	27,000	-	0	-	10,000
	0 - 2,100	32,000	-	0	-	10,000
October	3,340 - FULL	-	3,404.1	-	34,000	10,000
	2,970 - 3,340	22,000	-	0	-	10,000
	1,200 - 2,970	26,000	-	0	-	10,000
	0 - 1,200	32,000	-	0	-	10,000
November	3,160 - FULL	21,000	-	0	-	10,000
	3,000 - 3,160	20,000	-	0	-	10,000
	1000 - 3,000	26,000	-	0	-	10,000
	0 - 1,000	32,000	-	0	-	10,000
December	3,000 - FULL	17,000	-	204.1	-	10,000
	2,430 - 3,000	24,000	-	204.1	-	10,000
	500 - 2,430	28,000	-	204.1	-	10,000
	0 - 500	32,000	-	204.1	-	10,000
January	2,250 - FULL	24,000	-	204.1	-	12,000
	1,960 - 2,250	26,000	-	204.1	-	12,000
	1,800 - 1,960	27,000	-	204.1	-	12,000
	0 - 1,800	29,000	-	204.1	-	12,000
February	1,090 - FULL	26,000	-	0	-	12,000
	730 - 1,090	23,000	-	0	-	12,000
	680 - 730	20,000	-	0	-	12,000
	0 - 680	27,000	-	0	-	12,000
March	420 - FULL	25,000	-	0	-	12,000
	150 - 420	18,000	-	0	-	12,000
	0 - 150	26,000	-	0	-	12,000
April 1-15	890 - FULL	21,000	-	0	-	12,000
	290 - 890	12,000	-	0	-	12,000
	130 - 290	17,000	-	0	-	12,000
	0 - 130	21,000	-	0	-	12,000
April 16-30	220 - FULL	10,000	-	0	-	10,000
	130 - 220	14,000	-	0	-	10,000
	30 - 130	10,000	-	0	-	10,000
	0 - 30	15,000	-	0	-	10,000
May	220 - FULL	8,000	-	0	-	8,000
	160 - 220	15,000	-	0	-	8,000
	0 - 160	10,000	-	0	-	8,000
June	1,440 - FULL	8,000	-	0	-	8,000
	870 - 1,440	10,000	-	0	-	8,000
	0 - 870	16,000	-	0	-	8,000
July	2,950 - FULL	-	3,436.2	-	34,000	10,000
	2,000 - 2,950	18,000	-	0	-	10,000
	0 - 2,000	32,000	-	0	-	10,000

Notes:

1/ If the Mica target end-of-month storage content is less than 3529.2 ksfd, then a maximum outflow of 34000 cfs will apply.

2/ Mica outflows will be reduced to minimum to maintain the reservoir above the minimum Treaty storage content. This will override any flow target.

TABLE 1.1a
(English Units)
ARROW PROJECT OPERATING CRITERIA
DEFINITION
2016-17 ASSURED OPERATING PLAN

Period	Vol Runoff Period	The Dalles Vol Runoff (Maf)	Max Storage Limit 1/, 2/ (ksfd)	Max Outflow Limit 3/ (cfs)	Min Outflow Limit 4/ (cfs)
August 15 - December	-		URC	-	10,000
January	-		URC	70,000	10,000
February	1 Feb - 31 Jul	≤ 70	URC	60,000	20,000
		>70 to <80	URC to 1800		
		≥ 80	1800		
March	1 Mar - 31 Jul	≤ 65	URC	-	20,000
		>65 to <75	URC to 900		
		≥ 75	900		
April 15	1 Apr - 31 Jul	≤ 61	URC	-	15,000
		>61 to <70	URC to 900		
		≥ 70	900		
April 30	1 Apr - 31 Jul	≤ 61	URC	-	12,000
		>61 to <70	URC to 1000		
		≥ 70	1000		
May	1 May - 31 Jul	≤ 68	URC	-	5,000
		>68 to <70	URC to 2200		
		≥ 70	2200		
June	1 Jun - 31 Jul	≤ 33	URC	-	5,000
		>33 to <35	URC to 3300		
		≥ 35	3300		
July	-		URC	-	10,000

Notes:

1/ If the Maximum Storage Limit is computed to be above the URC, then the URC will apply.

2/ Interpolate when there are two values. For example, if the February-July volume runoff is between 70 Maf and 80 Maf, then the Maximum Storage Limit is interpolated between February's URC and 1800 ksfd.

3/ The Maximum Average Monthly Outflow Limit takes precedence over the Maximum Storage Limit. However, the Maximum Outflow Limit may be exceeded to avoid storage above the URC.

4/ The Minimum Average Monthly Outflow Limit is an operating limit and may be reduced to as low as 5,000 cfs (Treaty minimum) to avoid drafting Mica+Arrow storage beyond 14.1 Maf.

TABLE 1.1b
(English Units)
ARROW PROJECT OPERATING CRITERIA
30 YEAR OPERATING DATA
FOR 2016-17 ASSURED OPERATING PLAN

	AUG15-DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
Maximum Average Monthly Flow Limits (cfs)									
	-	70,000	60,000	-	-	-	-	-	-
Minimum Average Monthly Flow Limits (cfs)									
	10,000	10,000	20,000	20,000	15,000	12,000	5,000	5,000	10,000
End-of-Period Maximum Storage Limits (ksfd)									
1928-29	-	-	URC	URC	URC	URC	URC	URC	-
1929-30	-	-	URC	URC	URC	URC	URC	URC	-
1930-31	-	-	URC	URC	URC	URC	URC	URC	-
1931-32	-	-	1800.0	900.0	900.0	1000.0	2200.0	3300.0	-
1932-33	-	-	1800.0	900.0	900.0	1000.0	URC	URC	-
1933-34	-	-	1800.0	900.0	900.0	1000.0	URC	URC	-
1934-35	-	-	1800.0	900.0	900.0	1000.0	URC	3300.0	-
1935-36	-	-	1825.0	900.0	900.0	1000.0	URC	URC	-
1936-37	-	-	URC	URC	URC	URC	URC	3548.8	-
1937-38	-	-	1800.0	900.0	900.0	1000.0	URC	3300.0	-
1938-39	-	-	1947.9	960.4	1525.2	1574.3	URC	URC	-
1939-40	-	-	2203.3	1562.3	2333.2	2345.9	URC	URC	-
1940-41	-	-	URC	URC	URC	URC	URC	URC	-
1941-42	-	-	1800.0	900.0	900.0	1000.0	URC	URC	-
1942-43	-	-	1800.0	900.0	900.0	1000.0	2200.0	3300.0	-
1943-44	-	-	URC	URC	URC	URC	URC	URC	-
1944-45	-	-	1940.5	1116.9	1303.6	1370.2	URC	3300.0	-
1945-46	-	-	1800.0	900.0	900.0	1000.0	URC	3300.0	-
1946-47	-	-	1800.0	900.0	900.0	1000.0	2200.0	3300.0	-
1947-48	-	-	1800.0	900.0	900.0	1000.0	URC	3300.0	-
1948-49	-	-	1800.0	900.0	900.0	1000.0	URC	URC	-
1949-50	-	-	1800.0	900.0	900.0	1000.0	URC	URC	-
1950-51	-	-	1800.0	900.0	900.0	1000.0	URC	3300.0	-
1951-52	-	-	1800.0	900.0	900.0	1000.0	2200.0	3300.0	-
1952-53	-	-	1800.0	900.0	900.0	1000.0	URC	3300.0	-
1953-54	-	-	1800.0	900.0	900.0	1000.0	URC	URC	-
1954-55	-	-	1800.0	900.0	900.0	1000.0	URC	URC	-
1955-56	-	-	1800.0	900.0	900.0	1000.0	2200.0	3300.0	-
1956-57	-	-	1800.0	900.0	900.0	1000.0	2200.0	3300.0	-
1957-58	-	-	1800.0	900.0	900.0	1000.0	2200.0	3300.0	-

TABLE 1.1c
APOC IMPLEMENTATION
DISTRIBUTION FACTORS FOR THE DALLES
2016-17 ASSURED OPERATING PLAN

Forecast Date	Forecast Period	The Dalles Distribution Factors 1/					
		Jan-Jul	Feb-Jul	Mar-Jul	Apr-Jul	May-Jul	Jun-Jul
1-Jan	1 Jan - 31 Jul	1.0000	0.9392	0.8589	0.7735	0.7174	0.4393
1-Feb	1 Feb - 31 Jul		1.0000	0.9145	0.8235	0.7638	0.4677
1-Mar	1 Mar - 31 Jul			1.0000	0.9005	0.8352	0.5114
1-Apr	1 Apr - 31 Jul				1.0000	0.9275	0.5679
1-May	1 May - 31 Jul					1.0000	0.6123
1-Jun	1 Jun - 31 Jul						1.0000

Notes:

1/ Unless otherwise agreed, the DOP17 will apply these distribution factors to the monthly volume forecast at The Dalles for computing the Month-July runoff volumes required by the APOC. These distribution factors are calculated from the median 71 year Jan-Jul, Feb-Jul, etc., volumes.

For Example, in the month of May:

	From Table 1.1c			Look up Table 1.1a			
1 May Forecast Forecast Volume = 65 Maf (May-Jul)	The Dalles Distribution Factor	Month-Jul Volume Runoff (Maf)	Month-Jul Volume Runoff (km^3)	The Dalles Volume Runoff (Maf)	The Dalles Volume Runoff (km^3)	Maximum Storage Limit (ksfd)	Maximum Storage Limit (hm^3)
May	1.0000	65.0	80.2	$\leq$ 68	$\leq$ 83.9	URC	URC
June	0.6123	39.8	49.1	$\geq$ 35	$\geq$ 43.2	3300	8073.7

TABLE 2
COMPARISON OF 2015-16 ASSURED OPERATING PLAN
STUDY RESULTS (USED FOR THE 2016-17 ASSURED OPERATING PLAN)

Study 16-41 provides Optimum Generation in Canada and in the United States.
Study 16-11 provides Optimum Generation in the United States only.

	Study No. 16-41	Study No. 16-11	Net Gain	Weight	Value
1. Firm Energy Capability (aMW)					
U.S. System 1/	11935.6	11935.6	0.0		
Canada 2/, 3/	3017.5	2993.6	24.0		
Total	14953.1	14929.2	23.9	3	71.7
2. Dependable Peaking Capacity (MW)					
U.S. System 4/	28018.8	28020.9	-2.1		
Canada 2/, 5/	6423.7	6395.5	28.2		
Total	34442.5	34416.4	26.1	1	26.1
3. Average Annual Usable Secondary Energy (aMW)					
U.S. System 6/	3236.2	3218.6	17.6		
Canada 2/, 7/	289.9	306.1	-16.2		
Total	3526.1	3524.7	1.4	2	2.8
				Net Change in Value =	100.6

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

2/ Canadian system includes Mica, Arrow, Revelstoke, Kootenay Canal, Corra Linn, Upper Bonnington, Lower Bonnington, South Slocan, Brilliant, Seven Mile and Waneta.

3/ Canadian system firm energy capability was determined over the Canadian system critical period beginning 1 October 1940 and ending 30 April 1946.

4/ U.S. system dependable peaking capability was determined from February 1932.

5/ Canadian system dependable peaking capability was determined from December 1944.

6/ U.S. system 30-year average secondary energy limited to secondary market.

7/ Canadian system 30-year average generation minus firm energy capability.

TABLE 3
(English Units)
CRITICAL RULE CURVES
END OF PERIOD TREATY STORAGE CONTENTS (KSFD)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
							MICA							
1928-29	3529.2	3529.2	3492.2	3125.4	2872.8	2313.8	1989.8	757.0	652.1	626.9	604.1	1065.0	2665.1	3410.1
1929-30	3529.2	3529.2	3529.2	3168.1	3174.1	2204.1	752.1	74.1	0.0	0.0	215.6	862.8	2209.3	3508.8
1930-31	3484.6	3528.3	3482.1	3089.4	2878.2	2233.3	798.7	42.1	0.0	0.0	0.0	777.0	1646.9	2675.4
1931-32	3231.5	2402.2	1784.4	1445.6	891.7	146.2	0.3	0.0						
							ARROW							
1928-29	3579.6	3579.6	3451.4	3404.2	2733.9	2348.7	810.1	665.5	353.9	271.1	290.4	1207.2	2791.1	3501.3
1929-30	3501.9	3500.3	2961.3	2449.7	962.4	828.9	349.0	293.3	1.5	1.3	327.2	1427.1	2670.4	3156.8
1930-31	3421.1	3491.0	3255.7	2844.3	1684.7	763.8	467.3	112.6	0.0	0.0	0.0	393.8	1946.5	1490.1
1931-32	894.7	1654.0	1810.0	1287.3	675.6	138.5	11.7	0.0						
							DUNCAN							
1928-29	705.8	705.8	705.4	680.4	602.7	430.0	257.9	112.0	121.0	126.5	137.8	255.3	530.1	674.5
1929-30	704.5	703.8	600.0	575.0	550.0	504.1	260.9	76.2	0.0	0.0	33.1	148.1	314.8	524.5
1930-31	591.1	651.3	561.5	422.9	361.8	327.8	154.2	0.0	0.0	0.0	0.0	157.2	394.7	570.9
1931-32	576.9	564.3	471.7	308.7	102.0	0.0	0.0	0.0						
							COMPOSITE							
1928-29	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	3057.8	1534.5	1127.0	1024.5	1032.3	2527.5	5986.3	7585.9
1929-30	7735.6	7733.3	7090.5	6192.8	4686.5	3537.1	1362.0	443.6	1.5	1.3	575.9	2438.0	5194.5	7190.1
1930-31	7496.8	7670.6	7299.3	6356.6	4924.7	3324.9	1420.2	154.7	0.0	0.0	0.0	1328.0	3988.1	4736.4
1931-32	4703.1	4620.5	4066.1	3041.6	1669.3	284.7	12.0	0.0						

Note: Individual project rule curves are input to the AOP16 Step 1 study and adjusted to eliminate any Canadian composite crossovers according to Subsection 3(a) of this AOP17 document.

TABLE 4
(English Units)
MICA
ASSURED AND VARIABLE REFILL CURVES
DISTRIBUTION FACTORS AND FORECAST ERRORS
POWER DISCHARGE REQUIREMENTS, AND OPERATING RULE CURVE LOWER LIMITS
2016 - 17 ASSURED OPERATING PLAN

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
ASSURED REFILL CURVE (KSFD)														
	0.0	238.2	840.6	1019.2	1084.5	1101.0	1095.8	1084.3	1091.1	1116.1	1074.3	1603.4	2723.4	3529.2
VARIABLE REFILL CURVES (KSFD)														
1928-29							2023.0	1838.6	1781.3	1777.1	1817.4	2335.1	2919.8	3529.2
1929-30							999.6	773.8	708.0	723.1	878.8	1732.0	2629.7	"
1930-31							1257.7	1041.4	970.8	963.9	1053.4	1750.9	2706.1	"
1931-32							629.3	419.3	355.8	350.2	466.7	1277.2	2552.8	"
1932-33							535.8	361.1	315.0	307.3	384.0	1176.6	2386.6	"
1933-34							0.0	0.0	0.0	0.0	0.0	923.9	2643.8	"
1934-35							838.7	645.8	611.7	623.7	693.1	1414.7	2472.2	"
1935-36							639.1	446.2	401.0	392.9	487.1	1379.5	2740.4	"
1936-37							2009.7	1804.6	1732.6	1717.5	1805.9	2347.2	2952.1	"
1937-38							908.5	715.9	652.1	650.6	742.9	1500.3	2646.7	"
1938-39							1033.5	885.4	828.8	847.9	958.3	1745.2	2938.5	"
1939-40							816.7	631.3	592.4	605.7	734.4	1544.7	2693.9	"
1940-41							1442.9	1247.7	1196.3	1208.6	1384.9	2127.3	2933.9	"
1941-42							1342.8	1151.4	1091.9	1080.8	1156.2	1833.8	2808.8	"
1942-43							1546.1	1332.5	1269.7	1258.2	1410.0	2124.6	2890.1	"
1943-44							2115.4	1894.8	1836.3	1830.2	1898.2	2456.3	3094.8	"
1944-45							1996.9	1813.3	1768.7	1773.3	1822.3	2337.3	3004.4	"
1945-46							329.3	105.1	40.2	22.5	113.2	976.9	2548.7	"
1946-47							443.2	273.0	236.8	240.6	356.5	1236.3	2618.4	"
1947-48							392.0	201.1	149.8	127.5	206.9	1032.8	2502.6	"
1948-49							2090.3	1877.3	1797.3	1784.8	1861.7	2401.8	3291.3	"
1949-50							747.8	518.1	442.8	424.9	508.9	1252.9	2309.7	"
1950-51							739.1	557.1	513.8	513.7	626.8	1371.4	2679.2	"
1951-52							1146.2	922.4	853.2	829.2	910.2	1665.3	2829.8	"
1952-53							1427.8	1222.4	1162.5	1150.9	1209.9	1819.7	2796.0	"
1953-54							302.4	107.0	72.9	68.7	151.7	949.4	2281.2	"
1954-55							1063.0	885.1	842.0	843.5	929.3	1591.9	2479.9	"
1955-56							610.9	414.5	351.1	335.9	423.8	1269.9	2591.9	"
1956-57							779.7	576.3	527.4	524.2	612.8	1355.6	2929.8	"
1957-58							613.2	422.5	380.2	382.6	487.2	1252.9	2687.1	"
DISTRIBUTION FACTORS							0.9760	0.9800	0.9760	0.9820	0.9660	0.7910	0.5060	N/A
FORECAST ERRORS (KSFD)							728.0	522.0	455.0	420.0	420.0	401.0	397.0	N/A
POWER DISCHARGE REQUIREMENTS (CFS):														
ASSURED REFILL CURVE														
	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	10000	11000	22800	30500
VARIABLE REFILL CURVES					80	MAF	3000	3000	3000	3000	3000	3000	21000	25000
(BY VOLUME RUNOFF AT THE DALLE					95	MAF	3000	3000	3000	3000	3000	3000	16000	24000
					110	MAF	3000	3000	3000	3000	3000	3000	16000	24000
VARIABLE REFILL CURVE LOWER LIMIT					80	MAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(BY VOLUME RUNOFF AT THE DALLES					95	MAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					110	MAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATING RULE CURVE LOWER LIMITS (KSFD)							529.2	22.2	0.0	0.0				

Note: These refill curves are exactly the same as those used in AOP16.

TABLE 5
(English Units)
ARROW
ASSURED AND VARIABLE REFILL CURVES
DISTRIBUTION FACTORS AND FORECAST ERRORS
POWER DISCHARGE REQUIREMENTS, AND OPERATING RULE CURVE LOWER LIMITS
2016 - 17 ASSURED OPERATING PLAN

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
ASSURED REFILL CURVE (KSFD)														
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	274.2	355.7	436.5	710.2	2043.4	3579.3	3579.6
VARIABLE REFILL CURVES (KSFD)														
1928-29							1559.3	2115.7	2001.2	1931.6	2167.3	3000.7	3488.3	3579.6
1929-30							864.4	769.7	812.9	813.9	1090.4	2388.7	3369.3	"
1930-31							1111.0	977.9	961.9	958.3	1149.8	2243.6	3313.5	"
1931-32							0.0	0.0	0.0	0.0	0.0	1404.9	2966.3	"
1932-33							165.2	79.8	92.5	84.9	305.9	1549.1	2900.3	"
1933-34							0.0	0.0	0.0	0.0	62.4	2015.4	3396.4	"
1934-35							427.5	371.8	481.0	501.3	693.9	1805.3	3034.6	"
1935-36							508.8	356.7	310.3	274.1	450.6	1816.0	3329.9	"
1936-37							1868.6	2380.4	2255.4	2157.0	2414.0	3175.0	3579.6	"
1937-38							738.7	651.3	668.2	696.8	929.0	2050.8	3212.6	"
1938-39							1061.5	909.9	891.2	861.6	1110.1	2333.3	3579.6	"
1939-40							799.9	708.7	757.3	841.0	1126.1	2171.0	3395.6	"
1940-41							1561.3	1619.8	1563.9	1650.2	2196.4	3285.5	3579.6	"
1941-42							1632.6	1595.7	1533.1	1500.2	1776.3	2787.3	3526.1	"
1942-43							1890.3	1988.2	1899.7	1816.1	2220.3	3283.1	3579.6	"
1943-44							2380.8	2946.5	2844.7	2749.3	3025.3	3579.6	"	"
1944-45							1738.1	2349.3	2272.8	2231.4	2462.3	3192.5	"	"
1945-46							0.0	0.0	0.0	0.0	223.1	1528.8	3104.6	"
1946-47							517.1	433.4	437.1	455.3	715.3	1949.8	3204.0	"
1947-48							296.7	305.2	301.9	264.6	443.1	1643.7	3131.9	"
1948-49							1121.2	1695.5	1629.0	1571.6	1913.0	3017.3	3579.6	"
1949-50							322.8	211.1	227.5	224.1	433.2	1565.6	2776.0	"
1950-51							626.6	548.3	589.9	551.0	803.2	1919.3	3275.2	"
1951-52							659.9	540.6	560.6	530.1	723.0	2028.3	3351.0	"
1952-53							1038.7	1063.0	1009.6	952.8	1211.2	2292.6	3297.9	"
1953-54							0.0	0.0	0.0	0.0	57.1	1270.7	2785.0	"
1954-55							401.9	345.4	384.8	356.6	576.7	1760.0	2755.7	"
1955-56							104.8	6.3	25.2	16.1	257.0	1639.3	3134.6	"
1956-57							173.7	56.1	67.1	46.7	280.4	1496.2	3469.9	"
1957-58							0.0	0.0	0.0	0.0	290.2	1525.6	3171.2	"
DISTRIBUTION FACTORS							0.9740	0.9770	0.9710	0.9750	0.9520	0.7430	0.4680	N/A
FORECAST ERRORS (KSFD)							1485.0	1095.0	954.0	810.0	810.0	723.0	679.0	N/A
POWER DISCHARGE REQUIREMENTS (CFS):														
ASSURED REFILL CURVE														
	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	9000	25900	62800
VARIABLE REFILL CURVES					80	MAF	5000	5000	5000	5000	5000	5000	30000	48000
(BY VOLUME RUNOFF AT THE DALLE					95	MAF	5000	5000	5000	5000	5000	5000	30000	48000
					110	MAF	5000	5000	5000	5000	5000	5000	30000	48000
VARIABLE REFILL CURVE LOWER LIMIT					80	MAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(BY VOLUME RUNOFF AT THE DALLES					95	MAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					110	MAF	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATING RULE CURVE LOWER LIMITS (KSFD)							129.2	60.9	0.0	0.0				

Note: These refill curves are exactly the same as those used in AOP16.

TABLE 6

(English Units)
DUNCAN
ASSURED AND VARIABLE REFILL CURVES
DISTRIBUTION FACTORS AND FORECAST ERRORS
POWER DISCHARGE REQUIREMENTS, AND OPERATING RULE CURVE LOWER LIMITS
2016 - 17 ASSURED OPERATING PLAN

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
ASSURED REFILL CURVE (KSFD)	0.0	0.0	0.0	0.0	15.8	27.0	37.2	46.4	60.5	71.3	86.9	244.1	482.0	705.8
VARIABLE REFILL CURVES (KSFD)														
1928-29							340.2	322.5	331.6	329.7	345.7	451.0	604.7	705.8
1929-30							338.6	320.5	329.4	327.1	350.8	471.4	616.5	"
1930-31							282.9	266.2	278.7	281.5	303.7	421.1	604.7	"
1931-32							0.0	0.0	3.1	11.4	45.9	229.5	505.0	"
1932-33							"	"	0.0	0.0	0.0	55.1	366.6	"
1933-34							15.0	17.1	42.2	56.6	102.2	309.0	577.7	"
1934-35							65.5	55.5	79.5	81.5	105.0	268.9	501.9	"
1935-36							42.8	27.1	39.8	40.4	67.2	266.6	559.6	"
1936-37							275.8	257.2	268.4	266.5	286.9	406.3	585.9	"
1937-38							58.5	49.6	66.8	75.5	104.9	278.5	533.8	"
1938-39							118.9	107.7	121.5	125.2	156.2	326.7	588.4	"
1939-40							105.9	99.6	121.1	134.3	168.0	329.7	574.6	"
1940-41							191.5	182.4	199.8	214.7	259.6	410.6	599.2	"
1941-42							178.2	171.5	188.8	192.5	221.2	366.5	572.4	"
1942-43							188.5	174.5	190.4	192.6	230.7	386.5	563.0	"
1943-44							346.3	333.2	347.0	347.0	370.1	478.0	635.8	"
1944-45							266.5	253.7	268.6	269.3	286.9	404.6	591.8	"
1945-46							0.0	0.0	0.0	0.0	0.0	170.9	502.7	"
1946-47							"	"	"	"	12.0	215.1	512.5	"
1947-48							21.4	9.5	28.4	29.2	53.3	232.5	527.4	"
1948-49							247.9	230.9	243.4	242.4	267.1	403.6	629.8	"
1949-50							47.8	31.3	46.6	46.2	71.9	236.2	462.5	"
1950-51							0.0	0.0	0.0	0.0	13.2	200.7	494.8	"
1951-52							78.7	64.2	82.8	83.4	108.6	293.5	545.8	"
1952-53							75.8	"	80.7	82.8	105.0	268.0	508.2	"
1953-54							0.0	0.0	0.0	0.0	0.0	130.4	437.4	"
1954-55							11.6	"	16.1	19.2	46.4	212.9	437.3	"
1955-56							0.0	"	0.0	0.0	0.0	181.3	495.6	"
1956-57							31.6	13.2	27.9	30.4	58.8	231.1	564.1	"
1957-58							0.0	0.0	0.0	0.0	0.0	170.8	515.8	"
DISTRIBUTION FACTORS							0.9750	0.9810	0.9760	0.9790	0.9580	0.7530	0.4820	N/A
FORECAST ERRORS (KSFD)							128.0	104.0	105.0	94.0	94.0	87.0	78.0	N/A
POWER DISCHARGE REQUIREMENTS (CFS):														
ASSURED REFILL CURVE	100	100	100	100	100	100	100	100	100	100	100	100	100	100
VARIABLE REFILL CURVES (BY VOLUME RUNOFF AT THE DALLE					80 MAF		100	100	100	100	100	100	1200	2800
					95 MAF		100	100	100	100	100	100	1200	2500
					110 MAF		100	100	100	100	100	100	1200	2500
VARIABLE REFILL CURVE LOWER LIMIT (BY VOLUME RUNOFF AT THE DALLES					80 MAF		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					95 MAF		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					110 MAF		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATING RULE CURVE LOWER LIMITS (KSFD)							113.0	41.5	0.0	0.0				

Note: These refill curves are exactly the same as those used in AOP16.

TABLE 7

(English Units)
MICA
UPPER RULE CURVES (FLOOD CONTROL)
END OF PERIOD TREATY STORAGE CONTENTS (KSFD)
2016 - 17 ASSURED OPERATING PLAN

YEAR	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	3331.6	3203.9	3088.6	2960.8	2960.8	2960.8	3091.6	3529.2	3529.2
1929-30	,,	,,	,,	,,	,,	,,	3145.9	2978.5	2792.8	2792.8	2792.8	2825.9	3261.9	,,
1930-31	"	"	"	"	"	"	3331.6	3331.6	3331.6	3331.6	3331.6	3331.6	3529.2	"
1931-32	"	"	"	"	"	"	2698.3	2105.4	1472.2	1472.2	1472.2	2299.1	3387.3	"
1932-33	"	"	"	"	"	"	2691.3	2112.5	,,	,,	,,	1661.5	2868.9	"
1933-34	"	"	"	"	"	"	,,	,,	"	"	1838.3	2743.4	3216.5	"
1934-35	"	"	"	"	"	"	"	"	"	"	1472.2	1918.6	2873.0	"
1935-36	"	"	"	"	"	"	2698.3	2105.4	"	"	1556.5	2718.7	3529.2	"
1936-37	"	"	"	"	"	"	3109.9	2910.0	2688.3	2688.3	2688.3	2801.9	3394.7	"
1937-38	"	"	"	"	"	"	2691.3	2112.5	1472.2	1472.2	1513.3	2307.3	3253.6	"
1938-39	"	"	"	"	"	"	2835.9	2387.7	1892.0	1892.0	1959.1	3159.2	3306.6	"
1939-40	"	"	"	"	"	"	2993.8	2677.7	2339.9	2339.9	2339.9	3117.7	3340.1	"
1940-41	"	"	"	"	"	"	3319.5	3308.6	3296.5	3296.5	3296.5	3337.0	3394.4	"
1941-42	"	"	"	"	"	"	2691.3	2112.5	1472.2	1472.2	1472.2	1955.6	3280.3	"
1942-43	"	"	"	"	"	"	,,	,,	,,	,,	,,	1754.0	2831.9	"
1943-44	"	"	"	"	"	"	3331.6	3331.6	3331.6	3331.6	3331.6	3410.6	3529.2	"
1944-45	"	"	"	"	"	"	2829.2	2375.0	1872.6	1872.6	1872.6	2392.8	,,	"
1945-46	"	"	"	"	"	"	2691.3	2112.5	1472.2	1472.2	1472.2	2710.5	3296.8	"
1946-47	"	"	"	"	"	"	,,	,,	,,	,,	,,	2535.7	3529.2	"
1947-48	"	"	"	"	"	"	2698.3	2105.4	"	"	"	2327.9	,,	"
1948-49	"	"	"	"	"	"	2691.3	2112.5	"	"	1498.9	2430.8	3525.1	"
1949-50	"	"	"	"	"	"	,,	,,	"	"	1472.2	1472.2	2727.0	"
1950-51	"	"	"	"	"	"	"	"	"	"	,,	2469.8	3119.9	"
1951-52	"	"	"	"	"	"	2698.3	2105.4	"	"	1546.2	2498.6	3249.4	"
1952-53	"	"	"	"	"	"	2691.3	2112.5	"	"	1472.2	1953.5	3109.6	"
1953-54	"	"	"	"	"	"	,,	,,	"	"	,,	1863.0	2342.3	"
1954-55	"	"	"	"	"	"	"	"	"	"	"	1472.2	2926.5	3516.8
1955-56	"	"	"	"	"	"	2698.3	2105.4	"	"	"	2284.7	3282.4	3529.2
1956-57	"	"	"	"	"	"	2691.3	2112.5	"	"	"	3000.5	3529.2	"
1957-58	"	"	"	"	"	"	,,	,,	"	"	"	2574.8	,,	"

TABLE 8
(English Units)
ARROW
UPPER RULE CURVES (FLOOD CONTROL)
END OF PERIOD TREATY STORAGE CONTENTS (KSFD)
2016 - 17 ASSURED OPERATING PLAN

YEAR	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	3223.7	3188.4	3156.6	3121.4	3121.4	3121.4	3230.9	3579.6	3579.6
1929-30	,,	,,	,,	,,	,,	,,	3134.4	3053.9	2964.6	2964.6	2964.6	2964.6	,,	,,
1930-31	"	"	"	"	"	"	3223.7	3223.7	3223.7	3223.7	3223.7	3579.6	"	"
1931-32	"	"	"	"	"	"	2726.5	2261.7	1764.6	1764.6	1764.6	2359.9	"	"
1932-33	"	"	"	"	"	"	2721.0	2267.2	,,	,,	,,	1764.6	3211.2	"
1933-34	"	"	"	"	"	"	,,	,,	"	"	2151.2	2445.2	3579.6	"
1934-35	"	"	"	"	"	"	"	"	"	"	1764.6	2036.8	,,	"
1935-36	"	"	"	"	"	"	2726.5	2261.7	"	"	2180.2	2889.9	"	"
1936-37	"	"	"	"	"	"	3100.7	2989.8	2866.9	2866.9	2866.9	2895.3	"	"
1937-38	"	"	"	"	"	"	2721.0	2267.2	1764.6	1764.6	1764.6	2073.1	"	"
1938-39	"	"	"	"	"	"	2845.9	2504.8	2127.0	2127.0	2127.0	2283.9	"	"
1939-40	"	"	"	"	"	"	2990.9	2773.5	2540.8	2540.8	2540.8	3125.6	"	"
1940-41	"	"	"	"	"	"	3223.7	3223.7	3223.7	3223.7	3223.7	3342.5	"	"
1941-42	"	"	"	"	"	"	2721.0	2267.2	1764.6	1764.6	1764.6	2004.2	2908.0	"
1942-43	"	"	"	"	"	"	,,	,,	,,	,,	2289.1	2612.2	3579.6	"
1943-44	"	"	"	"	"	"	3223.7	3223.7	3223.7	3223.7	3223.7	3297.0	,,	"
1944-45	"	"	"	"	"	"	2840.2	2493.8	2110.3	2110.3	2110.3	2201.4	"	"
1945-46	"	"	"	"	"	"	2721.0	2267.2	1764.6	1764.6	1764.6	1933.4	"	"
1946-47	"	"	"	"	"	"	,,	,,	,,	,,	,,	2231.0	"	"
1947-48	"	"	"	"	"	"	2726.5	2261.7	"	"	"	2080.4	"	"
1948-49	"	"	"	"	"	"	2721.0	2267.2	"	"	"	2991.5	"	"
1949-50	"	"	"	"	"	"	,,	,,	"	"	"	1764.6	2621.3	"
1950-51	"	"	"	"	"	"	"	"	"	"	"	2107.6	3579.6	"
1951-52	"	"	"	"	"	"	2726.5	2261.7	"	"	1949.7	2724.7	,,	"
1952-53	"	"	"	"	"	"	2721.0	2267.2	"	"	1764.6	1764.6	"	"
1953-54	"	"	"	"	"	"	,,	,,	"	"	,,	2180.2	2675.7	"
1954-55	"	"	"	"	"	"	"	"	"	"	"	1770.0	2741.1	"
1955-56	"	"	"	"	"	"	2726.5	2261.7	"	"	1918.9	2626.7	3579.6	"
1956-57	"	"	"	"	"	"	2721.0	2267.2	"	"	1764.6	2664.8	,,	"
1957-58	"	"	"	"	"	"	,,	,,	"	"	,,	2697.5	"	"

TABLE 9
(English Units)
DUNCAN
UPPER RULE CURVES (FLOOD CONTROL)
END OF PERIOD TREATY STORAGE CONTENTS (KSFD)
2016 - 17 ASSURED OPERATING PLAN

YEAR	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	418.0	340.3	340.3	340.3	340.3	432.4	705.8	705.8
1929-30	,,	,,	,,	,,	,,	,,	408.7	322.6	322.6	322.6	322.6	436.1	655.2	,,
1930-31	"	"	"	"	"	"	390.7	288.3	288.3	288.3	292.9	434.1	656.1	"
1931-32	"	"	"	"	"	"	277.3	93.2	65.5	65.5	65.5	275.5	626.4	"
1932-33	"	"	"	"	"	"	273.7	,,	,,	,,	,,	132.7	492.6	689.8
1933-34	"	"	"	"	"	"	,,	"	"	"	509.2	605.3	687.2	705.8
1934-35	"	"	"	"	"	"	"	"	"	"	65.5	168.0	485.5	"
1935-36	"	"	"	"	"	"	277.3	"	"	"	104.6	337.0	660.3	"
1936-37	"	"	"	"	"	"	374.8	258.1	258.1	258.1	258.1	377.6	621.2	"
1937-38	"	"	"	"	"	"	290.1	115.9	96.8	96.8	116.9	294.1	631.5	"
1938-39	"	"	"	"	"	"	285.1	109.0	87.2	87.2	111.9	337.7	558.6	"
1939-40	"	"	"	"	"	"	301.1	126.5	111.4	111.4	111.4	305.7	582.7	"
1940-41	"	"	"	"	"	"	344.4	200.1	200.1	200.1	216.3	372.0	619.8	"
1941-42	"	"	"	"	"	"	326.1	165.6	165.3	165.3	165.3	316.7	540.9	"
1942-43	"	"	"	"	"	"	329.3	171.4	171.4	171.4	171.4	241.9	443.9	"
1943-44	"	"	"	"	"	"	412.5	327.2	327.2	327.2	327.2	440.4	672.1	"
1944-45	"	"	"	"	"	"	381.5	270.7	270.7	270.7	270.7	393.8	653.6	"
1945-46	"	"	"	"	"	"	273.7	93.2	65.5	65.5	73.2	326.8	677.6	"
1946-47	"	"	"	"	"	"	,,	,,	,,	,,	83.5	314.0	637.9	"
1947-48	"	"	"	"	"	"	277.3	"	"	"	65.5	249.9	658.4	"
1948-49	"	"	"	"	"	"	368.0	245.0	245.0	245.0	264.3	485.5	705.8	"
1949-50	"	"	"	"	"	"	273.7	93.2	65.5	65.5	65.5	181.4	534.2	"
1950-51	"	"	"	"	"	"	,,	,,	,,	,,	,,	527.8	606.5	"
1951-52	"	"	"	"	"	"	277.3	"	"	"	95.6	295.4	595.0	"
1952-53	"	"	"	"	"	"	273.7	"	"	"	65.5	188.4	489.4	"
1953-54	"	"	"	"	"	"	,,	"	"	"	,,	189.7	435.6	689.2
1954-55	"	"	"	"	"	"	"	"	"	"	"	72.6	435.0	694.9
1955-56	"	"	"	"	"	"	277.3	"	"	"	"	321.0	636.6	705.8
1956-57	"	"	"	"	"	"	273.7	"	"	"	71.9	376.7	691.7	"
1957-58	"	"	"	"	"	"	,,	"	"	"	65.5	334.4	683.4	"

TABLE 10
(English Units)
COMPOSITE OPERATING RULE CURVES
FOR THE WHOLE OF CANADIAN TREATY STORAGE
END OF PERIOD TREATY STORAGE CONTENTS (KSFD)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	3057.8	1861.8	1567.8	1679.1	1922.3	3902.1	6741.8	7814.6
1929-30	"	"	"	"	"	"	2067.6	1551.3	1184.7	1286.1	1726.8	3902.1	6529.1	,,
1930-31	"	"	"	"	"	"	2325.7	1818.9	1447.5	1526.9	1901.4	3902.1	6549.7	,,
1931-32	"	"	"	"	"	"	871.5	521.7	358.9	361.6	512.6	2911.6	6024.1	,,
1932-33	"	"	"	"	"	"	814.0	482.4	407.5	392.2	689.9	2780.8	5653.5	7798.6
1933-34	"	"	"	"	"	"	771.4	124.6	42.2	56.6	164.6	3194.6	6570.3	7814.6
1934-35	"	"	"	"	"	"	1379.2	1073.1	1032.9	1125.7	1452.5	3388.0	5992.3	,,
1935-36	"	"	"	"	"	"	1260.9	844.4	751.1	707.4	1004.9	3450.8	6583.4	,,
1936-37	"	"	"	"	"	"	3057.8	1861.8	1567.8	1679.1	1922.3	3902.1	6832.8	,,
1937-38	"	"	"	"	"	"	1760.2	1416.8	1074.6	1162.6	1558.0	3799.0	6389.4	,,
1938-39	"	"	"	"	"	"	1962.5	1658.6	1271.7	1371.6	1780.4	3902.1	6832.8	,,
1939-40	"	"	"	"	"	"	1729.6	1396.4	1059.5	1153.6	1556.0	3843.4	6619.6	,,
1940-41	"	"	"	"	"	"	2444.5	1861.8	1567.8	1679.1	1922.3	3902.1	6832.8	,,
1941-42	"	"	"	"	"	"	2331.1	1861.8	1567.8	1643.8	1922.3	3862.9	6161.5	,,
1942-43	"	"	"	"	"	"	2544.7	1861.8	1567.8	1679.1	1922.3	3888.7	6746.6	,,
1943-44	"	"	"	"	"	"	3057.8	1861.8	1567.8	1679.1	1922.3	3902.1	6832.8	,,
1944-45	"	"	"	"	"	"	3057.8	1861.8	1567.8	1679.1	1922.3	3902.1	6832.8	,,
1945-46	"	"	"	"	"	"	771.4	207.5	40.2	22.5	336.3	2676.6	6156.0	,,
1946-47	"	"	"	"	"	"	1159.3	747.9	592.5	677.1	1078.7	3401.2	6334.9	,,
1947-48	"	"	"	"	"	"	938.9	547.8	480.1	421.3	703.3	2909.0	6161.9	,,
1948-49	"	"	"	"	"	"	3047.8	1861.8	1567.8	1679.1	1922.3	3902.1	6832.8	,,
1949-50	"	"	"	"	"	"	1183.6	770.7	716.9	695.2	1007.6	2999.9	5393.5	,,
1950-51	"	"	"	"	"	"	1478.7	1146.9	869.5	950.2	1350.2	3491.4	6449.2	,,
1951-52	"	"	"	"	"	"	1919.1	1527.2	1274.4	1331.2	1716.0	3887.0	6604.5	,,
1952-53	"	"	"	"	"	"	2350.9	1814.0	1512.3	1618.1	1850.0	3556.4	6510.7	,,
1953-54	"	"	"	"	"	"	771.4	209.4	72.9	68.7	208.8	2350.5	5392.5	7798.0
1954-55	"	"	"	"	"	"	1577.9	1272.0	1213.8	1219.3	1552.4	3304.8	5656.0	7791.3
1955-56	"	"	"	"	"	"	853.1	516.9	376.3	352.0	680.8	3090.5	6222.1	7814.6
1956-57	"	"	"	"	"	"	1066.4	678.7	622.4	601.3	952.0	3082.9	6723.4	,,
1957-58	"	"	"	"	"	"	855.4	524.9	380.2	382.6	777.4	2949.3	6374.1	,,

TABLE 11
(English Units)
COMPOSITE END STORAGE
FOR THE WHOLE OF CANADIAN STORAGE
END OF PERIOD TREATY STORAGE CONTENTS (KSFD)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	3057.8	1534.5	1127.0	1024.5	1032.3	2527.5	5986.2	7585.9
1929-30	7735.6	7733.3	7090.5	6192.8	4686.5	3537.1	1362.0	443.6	1.5	1.3	575.9	2438.0	5194.5	7188.9
1930-31	7496.9	7670.6	7299.3	6356.5	4924.7	3324.9	1420.2	154.7	0.0	0.0	0.0	1328.0	3988.1	4736.0
1931-32	4702.8	4620.2	4065.8	3041.2	1668.9	284.4	11.6	0.0	2.6	122.4	462.8	2545.2	5979.7	7612.5
1932-33	7769.1	7814.6	7252.1	6476.2	6067.3	5092.5	2986.1	1356.8	407.5	342.7	550.3	2316.1	5653.5	7705.6
1933-34	7814.6	7814.6	7649.0	7210.0	6209.4	5166.6	3139.1	1549.7	920.0	771.1	1417.3	3194.6	5977.8	7519.8
1934-35	7673.6	7719.6	7053.5	6339.3	6209.4	5092.5	2996.1	1496.0	1032.9	692.3	851.2	2688.1	5801.3	7721.6
1935-36	7814.6	7799.2	7528.1	6765.0	5366.6	3876.6	1687.0	772.2	364.4	267.4	884.9	3450.8	6583.4	7669.9
1936-37	7731.5	7733.9	7169.5	6316.7	4685.1	3253.5	1229.1	170.5	0.0	0.0	0.0	1491.2	4467.0	6126.9
1937-38	6036.4	5934.4	5372.0	4617.9	4054.4	3346.7	1771.6	1334.8	647.9	547.2	680.9	2558.4	5657.7	7576.8
1938-39	7625.2	7705.8	7351.6	6660.5	5465.5	4560.9	2409.4	1648.6	1081.2	1113.3	1527.4	3600.9	5659.6	7721.6
1939-40	7811.4	7736.4	7103.7	6503.1	5350.5	4617.3	2496.3	1396.4	1059.5	1142.8	1453.2	3843.4	5798.8	7273.0
1940-41	7411.9	7371.5	7024.6	6672.0	5339.8	4119.3	2204.5	1248.3	1011.9	1228.6	1648.0	2980.2	4597.3	5333.9
1941-42	5284.9	5302.0	5194.6	5490.5	4775.5	4908.3	2758.7	1861.8	793.4	678.6	779.5	2488.4	4793.4	7020.0
1942-43	7490.2	7752.3	7300.8	6585.8	5744.0	5092.5	2871.2	1861.8	1021.0	988.9	1203.3	2545.0	4942.1	7277.0
1943-44	7664.6	7814.6	7567.5	7137.6	6067.6	5072.0	3057.8	1636.6	1085.1	1049.7	1124.5	2360.2	4385.5	4850.4
1944-45	4882.9	4844.4	4322.8	3560.6	2319.1	940.6	482.5	56.2	0.0	0.0	0.0	1827.9	4792.9	6367.8
1945-46	6231.9	6129.1	5562.7	4905.9	4080.7	3270.9	1103.1	207.5	0.0	0.0	283.0	2676.6	6156.0	7721.6
1946-47	7814.6	7814.6	7649.0	7174.6	6209.4	5092.5	2903.4	1276.6	592.5	617.4	1055.4	3401.2	6334.9	7814.6
1947-48	7814.6	7799.5	7649.0	7210.0	6209.4	5092.5	2935.0	1225.5	494.5	388.7	596.0	2909.0	6161.9	7814.6
1948-49	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	3047.8	1861.8	1468.4	1392.5	1489.7	3902.1	6115.6	7152.9
1949-50	7546.2	7684.7	7118.7	6489.8	5946.4	5092.5	2901.7	1247.9	716.9	653.1	735.2	2052.8	4954.3	7814.6
1950-51	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	3060.6	1443.1	935.0	957.8	1148.4	3491.4	6243.1	7814.6
1951-52	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	2902.8	1527.2	1109.1	1043.2	1509.3	3774.1	6490.8	7721.6
1952-53	7814.6	7790.4	7421.4	6693.9	5328.3	4150.2	2434.8	1814.0	965.5	787.8	854.8	2287.5	5477.8	7386.2
1953-54	7664.6	7814.6	7649.0	7210.0	6209.4	5092.5	2962.1	1409.9	543.8	280.0	208.8	2350.5	5358.1	7798.0
1954-55	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	3010.0	1416.2	1000.6	967.5	701.4	1883.1	5271.8	7791.3
1955-56	7814.6	7814.6	7649.0	7210.0	6209.4	5092.5	3034.0	1300.4	430.4	352.0	680.8	3090.5	6222.1	7721.6
1956-57	7776.9	7814.6	7649.0	7210.0	6209.4	5092.5	2923.0	1290.3	622.4	590.3	775.4	3082.9	6632.5	7721.6
1957-58	7677.7	7731.4	7274.0	6815.4	5791.8	5037.3	2897.2	1316.3	380.2	382.6	569.4	2949.3	6374.1	7721.6
Max	7814.6	7814.6	7649.0	7210.0	6209.4	5166.6	3139.1	1861.8	1468.4	1392.5	1648.0	3902.1	6632.5	7814.6
Median	7733.6	7771.4	7326.2	6683.0	5869.1	5082.3	2899.5	1345.8	682.4	635.3	777.5	2617.5	5729.2	7641.2
Average	7339.2	7361.1	7007.1	6429.8	5405.9	4358.7	2401.9	1195.3	660.5	612.8	826.6	2734.5	5601.7	7242.7
Min	4702.8	4620.2	4065.8	3041.2	1668.9	284.4	11.6	0.0	0.0	0.0	0.0	1328.0	3988.1	4736.0

TABLE 12
(English Units)
COMPARISON OF RECENT ASSURED OPERATING PLAN STUDIES

	2009-10	2010-11	2011-12 through 2013-14 1/	2014-15	2015-16 through 2016-17 3/
MICA TARGET OPERATION (ksfd or cfs)					
AUG 15	3454.2	3439.2	3364.2	3379.2	3379.2
AUG 31	FULL	FULL	FULL	FULL	FULL
SEP	FULL	FULL	FULL	FULL	FULL
OCT	3428.4	3428.4	3428.4	3428.4	3404.1
NOV	22000	21000	21000	22000	21000
DEC	25000	25000	25000	22000	17000
JAN	23000	27000	24000	24000	24000
FEB	20000	21000	21000	21000	26000
MAR	17000	21000	17000	25000	25000
APR 15	18000	22000	20000	17000	21000
APR 30	11000	10000	10000	10000	10000
MAY	10000	8000	8000	8000	8000
JUN	10000	8000	8000	10000	8000
JUL	3436.2	3467.2	3467.2	3467.2	3436.2
COMPOSITE CRC1 CANADIAN TREATY STORAGE CONTENT (ksfd)					
1928 AUG 31	7811.6	7794.1	7814.4	7814.6	7814.6
1928 DEC	5110.5	5086	5204.0	5282.1	5092.5
1929 APR15	671.5	1048.2	1084.4	1078.2	1024.5
1929 JUL	7168.9	7233.2	7329.8	7500.9	7585.9
COMPOSITE CANADIAN TREATY STORAGE CONTENT (ksfd)					
Pre AOP15: 60-Yr Avg, AOP15 -17: 70-Yr Avg 2/					
AUG 31	7455.5	7438.0	7362.8	7406.8	7415.3
DEC	4640.3	4612.9	4630.0	4644.6	4490.1
APR15	877.8	842.6	908.6	889.3	716.3
JUL	7277.6	7268.9	7147.1	7279.9	7303.8
STEP I GAINS AND LOSSES DUE TO REOPERATION (MW)					
U.S. Firm Energy	-0.3	-0.3	0.1	0.0	0.0
U.S. Dependable Peaking Capacity	-2.7	-19.1	-22.9	-3.9	-2.1
U.S. Average Annual Usable Secondary Energy	13.8	16.0	21.6	21.3	17.6
BCH Firm Energy	50.2	34.4	43.6	44.0	24.0
BCH Dependable Peaking Capacity	44.9	43.8	41.7	47.8	28.2
BCH Average Annual Usable Secondary Energy	-28.2	-20.8	-13.9	-33.4	-16.2
COORDINATED HYDRO MODEL LOAD (MW)					
AUG 15	11138	11138	10969	11187	11367
AUG 31	11166	11167	11104	10971	10944
SEP	10850	11025	11081	9756	9822
OCT	9783	9958	9920	9758	10051
NOV	11157	11333	11458	11821	12152
DEC	13193	13369	13316	13836	13744
JAN	13076	13076	12878	13323	13933
FEB	11901	11902	11721	13179	12876
MAR	11316	10967	10501	12022	11269
APR 15	10590	10241	9786	10476	10894
APR 30	12823	12475	11502	11012	11600
MAY	13491	13493	13287	12198	12166
JUN	14079	14080	13867	12208	11291
JUL	12724	12725	12531	11954	11812
ANNUAL AVERAGE	12038	12039	11856	11819	11794

1/ The AOP 2013-14 and 2012-13 utilize the same system regulation study as the 2011-12.

2/ Prior to AOP15, average content based on 60 years of modified flows. AOP15 through AOP17 averages based on 70 years of modified flows.

3/ The AOP 2016-17 utilizes the same Step 1 system regulation studies as used in the AOP 2015-16, so these coordinated hydro loads will be used for the DOP17 TSR unless otherwise agreed.

TABLE 1M
(Metric Units)
MICA PROJECT OPERATING CRITERIA
2016-17 ASSURED OPERATING PLAN

		Target Operation		Target Operation Limits		
Month	End of Previous Month **Arrow** Storage Content	Month Outflow (m^3/s)	End-of-Month Treaty Storage Content 1/ (hm^3)	Minimum Treaty Storage Content 2/ (hm^3)	Maximum Outflow 1/ (m^3/s)	Minimum Outflow (m^3/s)
August 1-15	8073.8 - FULL	-	8,267.6	-	962.77	424.75
	5260.2 - 8073.8	707.92	-	0.0	-	424.75
	0.0 - 5260.2	906.14	-	0.0	-	424.75
August 16-31	8563.1 - FULL	-	8,634.5	-	962.77	424.75
	5260.2 - 8563.1	707.92	-	0.0	-	424.75
	0.0 - 5260.2	906.14	-	0.0	-	424.75
September	8636.5 - FULL	-	8,634.5	-	962.77	283.17
	8563.1 - 8636.5	707.92	-	0.0	-	283.17
	5137.9 - 8563.1	764.55	-	0.0	-	283.17
	0.0 - 5137.9	906.14	-	0.0	-	283.17
October	8171.6 - FULL	-	8,328.5	-	962.77	283.17
	7266.4 - 8171.6	622.97	-	0.0	-	283.17
	2935.9 - 7266.4	736.24	-	0.0	-	283.17
	0.0 - 2935.9	906.14	-	0.0	-	283.17
November	7731.3 - FULL	594.65	-	0.0	-	283.17
	7339.8 - 7731.3	566.34	-	0.0	-	283.17
	2446.6 - 7339.8	736.24	-	0.0	-	283.17
	0.0 - 2446.6	906.14	-	0.0	-	283.17
December	7339.8 - FULL	481.39	-	499.4	-	283.17
	5945.2 - 7339.8	679.60	-	499.4	-	283.17
	1223.3 - 5945.2	792.87	-	499.4	-	283.17
	0.0 - 1223.3	906.14	-	499.4	-	283.17
January	5504.9 - FULL	679.60	-	499.4	-	339.80
	4795.3 - 5504.9	736.24	-	499.4	-	339.80
	4403.9 - 4795.3	764.55	-	499.4	-	339.80
	0.0 - 4403.9	821.19	-	499.4	-	339.80
February	2666.8 - FULL	736.24	-	0.0	-	339.80
	1786.0 - 2666.8	651.29	-	0.0	-	339.80
	1663.7 - 1786.0	566.34	-	0.0	-	339.80
	0.0 - 1663.7	764.55	-	0.0	-	339.80
March	1027.6 - FULL	707.92	-	0.0	-	339.80
	367.0 - 1027.6	509.70	-	0.0	-	339.80
	0.0 - 367.0	736.24	-	0.0	-	339.80
April 1-15	2177.5 - FULL	594.65	-	0.0	-	339.80
	709.5 - 2177.5	339.80	-	0.0	-	339.80
	318.1 - 709.5	481.39	-	0.0	-	339.80
	0.0 - 318.1	594.65	-	0.0	-	339.80
April 16-30	538.3 - FULL	283.17	-	0.0	-	283.17
	318.1 - 538.3	396.44	-	0.0	-	283.17
	73.4 - 318.1	283.17	-	0.0	-	283.17
	0.0 - 73.4	424.75	-	0.0	-	283.17
May	538.3 - FULL	226.53	-	0.0	-	226.53
	391.5 - 538.3	424.75	-	0.0	-	226.53
	0.0 - 391.5	283.17	-	0.0	-	226.53
June	3523.1 - FULL	226.53	-	0.0	-	226.53
	2128.5 - 3523.1	283.17	-	0.0	-	226.53
	0.0 - 2128.5	453.07	-	0.0	-	226.53
July	7217.5 - FULL	-	8,407.0	-	962.77	283.17
	4893.2 - 7217.5	509.70	-	0.0	-	283.17
	0.0 - 4893.2	906.14	-	0.0	-	283.17

1/ If the Mica target end-of-month storage content is less than 8634.5 hm^3, then a maximum outflow of 962.77 m^3/s will apply.
2/ Mica outflows will be reduced to minimum to maintain the reservoir above the minimum Treaty storage content. This will override any flow target.

TABLE 1.1aM
(Metric Units)
ARROW PROJECT OPERATING CRITERIA
DEFINITION
2016-17 ASSURED OPERATING PLAN

Period	Volume Runoff Period	The Dalles Volume Runoff (km^3)	Maximum Storage Limit 1/ 2/ (hm^3)	Maximum Outflow Limit 3/ (m^3/s)	Minimum Outflow Limit 4/ (m^3/s)
August 15 - December	-		URC	-	283.2
January	-		URC	1,982	283.2
February	1 Feb - 31 Jul	≤ 86	URC	1,699	566.3
		>86 to <99	URC to 4404.0		
		≥ 99	4404.0		
March	1 Mar - 31 Jul	≤ 80	URC	-	566.3
		>80 to <93	URC to 2202.0		
		≥ 93	2202.0		
April 15	1 Apr - 31 Jul	≤ 75	URC	-	424.8
		>75 to <86	URC to 2202.0		
		≥ 86	2202.0		
April 30	1 Apr - 31 Jul	≤ 75	URC	-	339.8
		>75 to <86	URC to 2447.0		
		≥ 86	2447.0		
May	1 May - 31 Jul	≤ 84	URC	-	141.6
		>84 to <86	URC to 5382.0		
		≥ 86	5382.0		
June	1 Jun - 31 Jul	≤ 41	URC	-	141.6
		>41 to <43	URC to 8074.0		
		≥ 43	8074.0		
July	-		URC	-	283.2

Notes:

1/ If the Maximum Storage Limit is computed to be above the URC, then the URC will apply.

2/ Interpolate when there are two values. For example, if the February-July volume runoff is between 86 km^3 and 99 km^3, then the Maximum Storage Limit is interpolated between February's URC and 4404 hm^3.

3/ The Maximum Average Monthly Outflow Limit takes precedence over the Maximum Storage Limit. However, the Maximum Outflow Limit may be exceeded to avoid storage above the URC.

4/ The Minimum Average Monthly Outflow Limit is an operating limit and may be reduced to as low as 141.6 m^3/s (Treaty minimum) to avoid drafting Mica+Arrow storage beyond 17.0 km^3.

TABLE 1.1bM
(Metric Units)
ARROW PROJECT OPERATING CRITERIA
30 YEAR OPERATING DATA
FOR 2016-17 ASSURED OPERATING PLAN

	AUG15-DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
Maximum Average Monthly Flow Limits (m^3/s)									
	-	1,982	1,699	-	-	-	-	-	-
Minimum Average Monthly Flow Limits (m^3/s)									
	283.2	283.2	566.3	566.3	424.8	339.8	141.6	141.6	283.2
End-of-Period Maximum Storage Limits (hm^3)									
1928-29	-	-	URC	URC	URC	URC	URC	URC	-
1929-30	-	-	URC	URC	URC	URC	URC	URC	-
1930-31	-	-	URC	URC	URC	URC	URC	URC	-
1931-32	-	-	4403.8	2201.9	2201.9	2446.6	5382.5	8073.7	-
1932-33	-	-	4403.8	2201.9	2201.9	2446.6	URC	URC	-
1933-34	-	-	4403.8	2201.9	2201.9	2446.6	URC	URC	-
1934-35	-	-	4403.8	2201.9	2201.9	2446.6	URC	8073.7	-
1935-36	-	-	4465.0	2201.9	2201.9	2446.6	URC	URC	-
1936-37	-	-	URC	URC	URC	URC	URC	8682.4	-
1937-38	-	-	4403.8	2201.9	2201.9	2446.6	URC	8073.7	-
1938-39	-	-	4765.7	2349.7	3731.5	3851.6	URC	URC	-
1939-40	-	-	5390.5	3822.3	5708.4	5739.4	URC	URC	-
1940-41	-	-	URC	URC	URC	URC	URC	URC	-
1941-42	-	-	4403.8	2201.9	2201.9	2446.6	URC	URC	-
1942-43	-	-	4403.8	2201.9	2201.9	2446.6	5382.5	8073.7	-
1943-44	-	-	URC	URC	URC	URC	URC	URC	-
1944-45	-	-	4747.6	2732.6	3189.4	3352.3	URC	8073.7	-
1945-46	-	-	4403.8	2201.9	2201.9	2446.6	URC	8073.7	-
1946-47	-	-	4403.8	2201.9	2201.9	2446.6	5382.5	8073.7	-
1947-48	-	-	4403.8	2201.9	2201.9	2446.6	URC	8073.7	-
1948-49	-	-	4403.8	2201.9	2201.9	2446.6	URC	URC	-
1949-50	-	-	4403.8	2201.9	2201.9	2446.6	URC	URC	-
1950-51	-	-	4403.8	2201.9	2201.9	2446.6	URC	8073.7	-
1951-52	-	-	4403.8	2201.9	2201.9	2446.6	5382.5	8073.7	-
1952-53	-	-	4403.8	2201.9	2201.9	2446.6	URC	8073.7	-
1953-54	-	-	4403.8	2201.9	2201.9	2446.6	URC	URC	-
1954-55	-	-	4403.8	2201.9	2201.9	2446.6	URC	URC	-
1955-56	-	-	4403.8	2201.9	2201.9	2446.6	5382.5	8073.7	-
1956-57	-	-	4403.8	2201.9	2201.9	2446.6	5382.5	8073.7	-
1957-58	-	-	4403.8	2201.9	2201.9	2446.6	5382.5	8073.7	-

TABLE 3M
(Metric Units)
CRITICAL RULE CURVES
END OF PERIOD TREATY STORAGE CONTENTS (hm^3)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
							MICA							
1928-29	8634.5	8634.5	8544.0	7646.6	7028.6	5660.9	4868.2	1852.1	1595.4	1533.8	1478.0	2605.6	6520.4	8343.2
1929-30	8634.5	8634.5	8634.5	7751.1	7765.8	5392.6	1840.1	181.3	0.0	0.0	527.5	2110.9	5405.3	8584.6
1930-31	8525.4	8632.3	8519.3	7558.5	7041.8	5464.0	1954.1	103.0	0.0	0.0	0.0	1901.0	4029.3	6545.6
1931-32	7906.2	5877.2	4365.7	3536.8	2181.6	357.7	0.7	0.0						
							ARROW							
1928-29	8757.8	8757.8	8444.2	8328.7	6688.8	5746.3	1982.0	1628.2	865.9	663.3	710.5	2953.5	6828.7	8566.3
1929-30	8567.7	8563.8	7245.1	5993.4	2354.6	2028.0	853.9	717.6	3.7	3.2	800.5	3491.5	6533.4	7723.4
1930-31	8370.1	8541.1	7965.4	6958.9	4121.8	1868.7	1143.3	275.5	0.0	0.0	0.0	963.5	4762.3	3645.7
1931-32	2189.0	4046.7	4428.3	3149.5	1652.9	338.9	28.6	0.0						
							DUNCAN							
1928-29	1726.8	1726.8	1725.8	1664.7	1474.6	1052.0	631.0	274.0	296.0	309.5	337.1	624.6	1296.9	1650.2
1929-30	1723.6	1721.9	1468.0	1406.8	1345.6	1233.3	638.3	186.4	0.0	0.0	81.0	362.3	770.2	1283.2
1930-31	1446.2	1593.5	1373.8	1034.7	885.2	802.0	377.3	0.0	0.0	0.0	0.0	384.6	965.7	1396.8
1931-32	1411.4	1380.6	1154.1	755.3	249.6	0.0	0.0	0.0						
							COMPOSITE							
1928-29	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7481.2	3754.3	2757.3	2506.5	2525.6	6183.8	14646.1	18559.7
1929-30	18925.9	18920.3	17347.6	15151.3	11466.0	8653.9	3332.3	1085.3	3.7	3.2	1409.0	5964.8	12708.9	17591.3
1930-31	18341.7	18766.9	17858.5	15552.1	12048.8	8134.7	3474.7	378.5	0.0	0.0	0.0	3249.1	9757.3	11588.1
1931-32	11506.6	11304.5	9948.1	7441.6	4084.1	696.5	29.4	0.0						

TABLE 4M
(Metric Units)
MICA
ASSURED AND VARIABLE REFILL CURVES,
DISTRIBUTION FACTORS AND FORECAST ERRORS,
POWER DISCHARGE REQUIREMENTS, AND OPERATING RULE CURVE LOWER LIMITS
2016 - 17 ASSURED OPERATING PLAN

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
ASSURED REFILL CURVE (hm^3)														
	0.0	582.8	2056.6	2493.6	2653.3	2693.7	2681.0	2652.8	2669.5	2730.7	2628.4	3922.9	6663.1	8634.5
VARIABLE REFILL CURVES (hm^3)														
1928-29							4949.5	4498.3	4358.1	4347.9	4446.5	5713.1	7143.6	8634.5
1929-30							2445.6	1893.2	1732.2	1769.1	2150.1	4237.5	6433.8	"
1930-31							3077.1	2547.9	2375.2	2358.3	2577.2	4283.8	6620.7	"
1931-32							1539.6	1025.9	870.5	856.8	1141.8	3124.8	6245.7	"
1932-33							1310.9	883.5	770.7	751.8	939.5	2878.7	5839.1	"
1933-34							0.0	0.0	0.0	0.0	0.0	2260.4	6468.3	"
1934-35							2052.0	1580.0	1496.6	1525.9	1695.7	3461.2	6048.5	"
1935-36							1563.6	1091.7	981.1	961.3	1191.7	3375.1	6704.7	"
1936-37							4916.9	4415.1	4239.0	4202.0	4418.3	5742.7	7222.6	"
1937-38							2222.7	1751.5	1595.4	1591.8	1817.6	3670.6	6475.4	"
1938-39							2528.6	2166.2	2027.7	2074.5	2344.6	4269.8	7189.3	"
1939-40							1998.1	1544.5	1449.4	1481.9	1796.8	3779.3	6590.9	"
1940-41							3530.2	3052.6	2926.9	2957.0	3388.3	5204.7	7178.1	"
1941-42							3285.3	2817.0	2671.4	2644.3	2828.8	4486.6	6872.0	"
1942-43							3782.7	3260.1	3106.4	3078.3	3449.7	5198.0	7070.9	"
1943-44							5175.5	4635.8	4492.7	4477.8	4644.1	6009.6	7571.7	"
1944-45							4885.6	4436.4	4327.3	4338.6	4458.4	5718.4	7350.6	"
1945-46							805.7	257.1	98.4	55.0	277.0	2390.1	6235.6	"
1946-47							1084.3	667.9	579.4	588.7	872.2	3024.7	6406.2	"
1947-48							959.1	492.0	366.5	311.9	506.2	2526.8	6122.9	"
1948-49							5114.1	4593.0	4397.3	4366.7	4554.8	5876.2	8052.5	"
1949-50							1829.6	1267.6	1083.4	1039.6	1245.1	3065.3	5650.9	"
1950-51							1808.3	1363.0	1257.1	1256.8	1533.5	3355.3	6554.9	"
1951-52							2804.3	2256.7	2087.4	2028.7	2226.9	4074.3	6923.4	"
1952-53							3493.3	2990.7	2844.2	2815.8	2960.1	4452.1	6840.7	"
1953-54							739.9	261.8	178.4	168.1	371.1	2322.8	5581.2	"
1954-55							2600.7	2165.5	2060.0	2063.7	2273.6	3894.7	6067.3	"
1955-56							1494.6	1014.1	859.0	821.8	1036.9	3106.9	6341.3	"
1956-57							1907.6	1410.0	1290.3	1282.5	1499.3	3316.6	7168.0	"
1957-58							1500.3	1033.7	930.2	936.1	1192.0	3065.3	6574.3	"
DISTRIBUTION FACTORS							0.9760	0.9800	0.9760	0.9820	0.9660	0.7910	0.5060	N/A
FORECAST ERRORS (hm^3)							1781.1	1277.1	1113.2	1027.6	1027.6	981.1	971.3	N/A
POWER DISCHARGE REQUIREMENTS (m^3/s):														
ASSURED REFILL CURVE														
	84.95	84.95	84.95	84.95	84.95	84.95	84.95	84.95	84.95	84.95	283.17	311.49	645.62	863.66
VARIABLE REFILL CURVES					98.68 km^3		84.95	84.95	84.95	84.95	84.95	84.95	594.65	707.92
(BY VOLUME RUNOFF AT THE DALLES)					117.18 km^3		84.95	84.95	84.95	84.95	84.95	84.95	453.07	679.60
					135.69 km^3		84.95	84.95	84.95	84.95	84.95	84.95	453.07	679.60
VARIABLE REFILL CURVE LOWER LIMITS (hm^3)					98.68 km^3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(By VOLUME RUNOFF AT THE DALLES)					117.18 km^3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					135.69 km^3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATING RULE CURVE LOWER LIMITS (hm^3)							1294.7	54.3	0.0	0.0				

Note: These refill curves are exactly the same as those used in AOP16.

TABLE 5M

(Metric Units)
ARROW
ASSURED AND VARIABLE REFILL CURVES,
DISTRIBUTION FACTORS AND FORECAST ERRORS,
POWER DISCHARGE REQUIREMENTS, AND OPERATING RULE CURVE LOWER LIMITS
2016 - 17 ASSURED OPERATING PLAN

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
ASSURED REFILL CURVE (hm^3)														
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	670.9	870.3	1067.9	1737.6	4999.4	8757.1	8757.8
VARIABLE REFILL CURVES (hm^3)														
1928-29							3815.0	5176.3	4896.1	4725.9	5302.5	7341.5	8534.5	8757.8
1929-30							2114.8	1883.1	1988.8	1991.3	2667.8	5844.2	8243.3	"
1930-31							2718.2	2392.5	2353.4	2344.6	2813.1	5489.2	8106.8	"
1931-32							0.0	0.0	0.0	0.0	0.0	3437.2	7257.3	"
1932-33							404.2	195.2	226.3	207.7	748.4	3790.0	7095.9	"
1933-34							0.0	0.0	0.0	0.0	152.7	4930.9	8309.6	"
1934-35							1045.9	909.6	1176.8	1226.5	1697.7	4416.8	7424.5	"
1935-36							1244.8	872.7	759.2	670.6	1102.4	4443.0	8146.9	"
1936-37							4571.7	5823.9	5518.1	5277.3	5906.1	7768.0	8757.8	"
1937-38							1807.3	1593.5	1634.8	1704.8	2272.9	5017.5	7859.9	"
1938-39							2597.1	2226.2	2180.4	2108.0	2716.0	5708.7	8757.8	"
1939-40							1957.0	1733.9	1852.8	2057.6	2755.1	5311.6	8307.7	"
1940-41							3819.9	3963.0	3826.2	4037.4	5373.7	8038.3	8757.8	"
1941-42							3994.3	3904.0	3750.9	3670.4	4345.9	6819.4	8627.0	"
1942-43							4624.8	4864.3	4647.8	4443.3	5432.2	8032.4	8757.8	"
1943-44							5824.9	7208.9	6959.8	6726.4	7401.7	8757.8	"	"
1944-45							4252.4	5747.8	5560.6	5459.3	6024.3	7810.8	"	"
1945-46							0.0	0.0	0.0	0.0	545.8	3740.4	7595.7	"
1946-47							1265.1	1060.4	1069.4	1113.9	1750.1	4770.4	7838.9	"
1947-48							725.9	746.7	738.6	647.4	1084.1	4021.5	7662.5	"
1948-49							2743.1	4148.2	3985.5	3845.1	4680.3	7382.1	8757.8	"
1949-50							789.8	516.5	556.6	548.3	1059.9	3830.4	6791.8	"
1950-51							1533.0	1341.5	1443.2	1348.1	1965.1	4695.8	8013.1	"
1951-52							1614.5	1322.6	1371.6	1296.9	1768.9	4962.4	8198.6	"
1952-53							2541.3	2600.7	2470.1	2331.1	2963.3	5609.1	8068.6	"
1953-54							0.0	0.0	0.0	0.0	139.7	3108.9	6813.8	"
1954-55							983.3	845.1	941.5	872.5	1411.0	4306.0	6742.1	"
1955-56							256.4	15.4	61.7	39.4	628.8	4010.7	7669.1	"
1956-57							425.0	137.3	164.2	114.3	686.0	3660.6	8489.5	"
1957-58							0.0	0.0	0.0	0.0	710.0	3732.5	7758.7	"
DISTRIBUTION FACTORS							0.9740	0.9770	0.9710	0.9750	0.9520	0.7430	0.4680	N/A
FORECAST ERRORS (hm^3)							3633.2	2679.0	2334.1	1981.7	1981.7	1768.9	1661.2	N/A
POWER DISCHARGE REQUIREMENTS (m^3/s):														
ASSURED REFILL CURVE														
	141.58	141.58	141.58	141.58	141.58	141.58	141.58	141.58	141.58	141.58	141.58	254.85	733.41	1778.30
VARIABLE REFILL CURVES					98.68	km^3	141.58	141.58	141.58	141.58	141.58	141.58	849.50	1359.21
(BY VOLUME RUNOFF AT THE DALLES)					117.18	km^3	141.58	141.58	141.58	141.58	141.58	141.58	849.50	1359.21
					135.69	km^3	141.58	141.58	141.58	141.58	141.58	141.58	849.50	1359.21
VARIABLE REFILL CURVE LOWER LIMITS (hm^3)					98.68	km^3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(By VOLUME RUNOFF AT THE DALLES)					117.18	km^3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					135.69	km^3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATING RULE CURVE LOWER LIMITS (hm^3)							316.1	149.0	0.0	0.0				

Note: These refill curves are exactly the same as those used in AOP16.

TABLE 6M
(Metric Units)

DUNCAN
ASSURED AND VARIABLE REFILL CURVES,
DISTRIBUTION FACTORS AND FORECAST ERRORS,
POWER DISCHARGE REQUIREMENTS, AND OPERATING RULE CURVE LOWER LIMITS
2016 - 17 ASSURED OPERATING PLAN

	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
ASSURED REFILL CURVE (hm^3)														
	0.0	0.0	0.0	0.0	38.7	66.1	91.0	113.5	148.0	174.4	212.6	597.2	1179.3	1726.8
VARIABLE REFILL CURVES (hm^3)														
1928-29							832.3	789.0	811.3	806.6	845.8	1103.4	1479.5	1726.8
1929-30							828.4	784.1	805.9	800.3	858.3	1153.3	1508.3	"
1930-31							692.1	651.3	681.9	688.7	743.0	1030.3	1479.5	"
1931-32							0.0	0.0	7.6	27.9	112.3	561.5	1235.5	"
1932-33							"	"	0.0	0.0	0.0	134.8	896.9	"
1933-34							36.7	41.8	103.2	138.5	250.0	756.0	1413.4	"
1934-35							160.3	135.8	194.5	199.4	256.9	657.9	1227.9	"
1935-36							104.7	66.3	97.4	98.8	164.4	652.3	1369.1	"
1936-37							674.8	629.3	656.7	652.0	701.9	994.1	1433.5	"
1937-38							143.1	121.4	163.4	184.7	256.6	681.4	1306.0	"
1938-39							290.9	263.5	297.3	306.3	382.2	799.3	1439.6	"
1939-40							259.1	243.7	296.3	328.6	411.0	806.6	1405.8	"
1940-41							468.5	446.3	488.8	525.3	635.1	1004.6	1466.0	"
1941-42							436.0	419.6	461.9	471.0	541.2	896.7	1400.4	"
1942-43							461.2	426.9	465.8	471.2	564.4	945.6	1377.4	"
1943-44							847.3	815.2	849.0	849.0	905.5	1169.5	1555.5	"
1944-45							652.0	620.7	657.2	658.9	701.9	989.9	1447.9	"
1945-46							0.0	0.0	0.0	0.0	0.0	418.1	1229.9	"
1946-47							"	"	"	"	29.4	526.3	1253.9	"
1947-48							52.4	23.2	69.5	71.4	130.4	568.8	1290.3	"
1948-49							606.5	564.9	595.5	593.1	653.5	987.4	1540.9	"
1949-50							116.9	76.6	114.0	113.0	175.9	577.9	1131.6	"
1950-51							0.0	0.0	0.0	0.0	32.3	491.0	1210.6	"
1951-52							192.5	157.1	202.6	204.0	265.7	718.1	1335.4	"
1952-53							185.5	"	197.4	202.6	256.9	655.7	1243.4	"
1953-54							0.0	0.0	0.0	0.0	0.0	319.0	1070.1	"
1954-55							28.4	"	39.4	47.0	113.5	520.9	1069.9	"
1955-56							0.0	"	0.0	0.0	0.0	443.6	1212.5	"
1956-57							77.3	32.3	68.3	74.4	143.9	565.4	1380.1	"
1957-58							0.0	0.0	0.0	0.0	0.0	417.9	1262.0	"
DISTRIBUTION FACTORS							0.9750	0.9810	0.9760	0.9790	0.9580	0.7530	0.4820	N/A
FORECAST ERRORS (hm^3)							313.2	254.4	256.9	230.0	230.0	212.9	190.8	N/A
POWER DISCHARGE REQUIREMENTS (m^3/s):														
ASSURED REFILL CURVE														
	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83	2.83
VARIABLE REFILL CURVES					98.68 km^3		2.83	2.83	2.83	2.83	2.83	2.83	33.98	79.29
(BY VOLUME RUNOFF AT THE DALLES)					117.18 km^3		2.83	2.83	2.83	2.83	2.83	2.83	33.98	70.79
					135.69 km^3		2.83	2.83	2.83	2.83	2.83	2.83	33.98	70.79
VARIABLE REFILL CURVE LOWER LIMITS (hm^3)					98.68 km^3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
(By VOLUME RUNOFF AT THE DALLES)					117.18 km^3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
					135.69 km^3		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OPERATING RULE CURVE LOWER LIMITS (hm^3)							276.5	101.5	0.0	0.0				

Note: These refill curves are exactly the same as those used in AOP16.

TABLE 7M
(Metric Units)
MICA

UPPER RULE CURVES (FLOOD CONTROL)
END OF PERIOD TREATY STORAGE CONTENTS (hm^3)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	8634.5	8634.5	8634.5	8387.9	8387.9	8151.1	7838.7	7556.6	7243.9	7243.9	7243.9	7563.9	8634.5	8634.5
1929-30	"	"	"	"	"	"	7696.8	7287.2	6832.9	6832.9	6832.9	6913.8	7980.6	"
1930-31	"	"	"	"	"	"	8151.1	8151.1	8151.1	8151.1	8151.1	8151.1	8634.5	"
1931-32	"	"	"	"	"	"	6601.7	5151.1	3601.9	3601.9	3601.9	5625.0	8287.4	"
1932-33	"	"	"	"	"	"	6584.5	5168.4	"	"	"	4065.0	7019.1	"
1933-34	"	"	"	"	"	"	"	"	"	"	4497.6	6712.0	7869.5	"
1934-35	"	"	"	"	"	"	"	"	"	"	3601.9	4694.0	7029.1	"
1935-36	"	"	"	"	"	"	6601.7	5151.1	"	"	3808.1	6651.6	8634.5	"
1936-37	"	"	"	"	"	"	7608.7	7119.6	6577.2	6577.2	6577.2	6855.1	8305.5	"
1937-38	"	"	"	"	"	"	6584.5	5168.4	3601.9	3601.9	3702.4	5645.0	7960.3	"
1938-39	"	"	"	"	"	"	6938.3	5841.7	4629.0	4629.0	4793.1	7729.3	8089.9	"
1939-40	"	"	"	"	"	"	7324.6	6551.3	5724.8	5724.8	5724.8	7627.8	8171.9	"
1940-41	"	"	"	"	"	"	8121.5	8094.8	8065.2	8065.2	8065.2	8164.3	8304.7	"
1941-42	"	"	"	"	"	"	6584.5	5168.4	3601.9	3601.9	3601.9	4784.6	8025.6	"
1942-43	"	"	"	"	"	"	"	"	"	"	"	4291.3	6928.5	"
1943-44	"	"	"	"	"	"	8151.1	8151.1	8151.1	8151.1	8151.1	8344.4	8634.5	"
1944-45	"	"	"	"	"	"	6921.9	5810.7	4581.5	4581.5	4581.5	5854.2	"	"
1945-46	"	"	"	"	"	"	6584.5	5168.4	3601.9	3601.9	3601.9	6631.5	8066.0	"
1946-47	"	"	"	"	"	"	"	"	"	"	"	6203.8	8634.5	"
1947-48	"	"	"	"	"	"	6601.7	5151.1	"	"	"	5695.4	"	"
1948-49	"	"	"	"	"	"	6584.5	5168.4	"	"	3667.2	5947.2	8624.5	"
1949-50	"	"	"	"	"	"	"	"	"	"	3601.9	3601.9	6671.9	"
1950-51	"	"	"	"	"	"	"	"	"	"	"	6042.6	7633.1	"
1951-52	"	"	"	"	"	"	6601.7	5151.1	"	"	3782.9	6113.1	7950.0	"
1952-53	"	"	"	"	"	"	6584.5	5168.4	"	"	3601.9	4779.4	7607.9	"
1953-54	"	"	"	"	"	"	"	"	"	"	"	4558.0	5730.7	"
1954-55	"	"	"	"	"	"	"	"	"	"	"	3601.9	7160.0	8604.2
1955-56	"	"	"	"	"	"	6601.7	5151.1	"	"	"	5589.7	8030.7	8634.5
1956-57	"	"	"	"	"	"	6584.5	5168.4	"	"	"	7341.0	8634.5	"
1957-58	"	"	"	"	"	"	"	"	"	"	"	6299.5	"	"

TABLE 8M
(Metric Units)
ARROW
UPPER RULE CURVES (FLOOD CONTROL)
END OF PERIOD TREATY STORAGE CONTENTS (hm^3)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	8757.8	8757.8	8757.8	8449.6	8449.6	7887.1	7800.7	7722.9	7636.8	7636.8	7636.8	7904.7	8757.8	8757.8
1929-30	"	"	"	"	"	"	7668.6	7471.7	7253.2	7253.2	7253.2	7253.2	"	"
1930-31	"	"	"	"	"	"	7887.1	7887.1	7887.1	7887.1	7887.1	8757.8	"	"
1931-32	"	"	"	"	"	"	6670.7	5533.5	4317.3	4317.3	4317.3	5773.7	"	"
1932-33	"	"	"	"	"	"	6657.2	5546.9	"	"	"	4317.3	7856.5	"
1933-34	"	"	"	"	"	"	"	"	"	"	5263.1	5982.4	8757.8	"
1934-35	"	"	"	"	"	"	"	"	"	"	4317.3	4983.2	"	"
1935-36	"	"	"	"	"	"	6670.7	5533.5	"	"	5334.1	7070.4	"	"
1936-37	"	"	"	"	"	"	7586.2	7314.8	7014.2	7014.2	7014.2	7083.6	"	"
1937-38	"	"	"	"	"	"	6657.2	5546.9	4317.3	4317.3	4317.3	5072.0	"	"
1938-39	"	"	"	"	"	"	6962.8	6128.2	5203.9	5203.9	5203.9	5587.8	"	"
1939-40	"	"	"	"	"	"	7317.5	6785.6	6216.3	6216.3	6216.3	7647.1	"	"
1940-41	"	"	"	"	"	"	7887.1	7887.1	7887.1	7887.1	7887.1	8177.8	"	"
1941-42	"	"	"	"	"	"	6657.2	5546.9	4317.3	4317.3	4317.3	4903.5	7114.7	"
1942-43	"	"	"	"	"	"	"	"	"	"	5600.5	6391.0	8757.8	"
1943-44	"	"	"	"	"	"	7887.1	7887.1	7887.1	7887.1	7887.1	8066.4	"	"
1944-45	"	"	"	"	"	"	6948.8	6101.3	5163.1	5163.1	5163.1	5385.9	"	"
1945-46	"	"	"	"	"	"	6657.2	5546.9	4317.3	4317.3	4317.3	4730.3	"	"
1946-47	"	"	"	"	"	"	"	"	"	"	"	5458.4	"	"
1947-48	"	"	"	"	"	"	6670.7	5533.5	"	"	"	5089.9	"	"
1948-49	"	"	"	"	"	"	6657.2	5546.9	"	"	"	7319.0	"	"
1949-50	"	"	"	"	"	"	"	"	"	"	"	4317.3	6413.3	"
1950-51	"	"	"	"	"	"	"	"	"	"	"	5156.5	8757.8	"
1951-52	"	"	"	"	"	"	6670.7	5533.5	"	"	4770.1	6666.3	"	"
1952-53	"	"	"	"	"	"	6657.2	5546.9	"	"	4317.3	4317.3	"	"
1953-54	"	"	"	"	"	"	"	"	"	"	"	5334.1	6546.4	"
1954-55	"	"	"	"	"	"	"	"	"	"	"	4330.5	6706.4	"
1955-56	"	"	"	"	"	"	6670.7	5533.5	"	"	4694.8	6426.5	8757.8	"
1956-57	"	"	"	"	"	"	6657.2	5546.9	"	"	4317.3	6519.7	"	"
1957-58	"	"	"	"	"	"	"	"	"	"	"	6599.7	"	"

TABLE 9M
(Metric Units)
DUNCAN
UPPER RULE CURVES (FLOOD CONTROL)
END OF PERIOD TREATY STORAGE CONTENTS (hm^3)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	1726.8	1726.8	1726.8	1726.8	1726.8	1233.3	1022.7	832.6	832.6	832.6	832.6	1057.9	1726.8	1726.8
1929-30	"	"	"	"	"	"	999.9	789.3	789.3	789.3	789.3	1067.0	1603.0	"
1930-31	"	"	"	"	"	"	955.9	705.4	705.4	705.4	716.6	1062.1	1605.2	"
1931-32	"	"	"	"	"	"	678.4	228.0	160.3	160.3	160.3	674.0	1532.6	"
1932-33	"	"	"	"	"	"	669.6	"	"	"	"	324.7	1205.2	1687.7
1933-34	"	"	"	"	"	"	"	"	"	"	1245.8	1480.9	1681.3	1726.8
1934-35	"	"	"	"	"	"	"	"	"	"	160.3	411.0	1187.8	"
1935-36	"	"	"	"	"	"	678.4	"	"	"	255.9	824.5	1615.5	"
1936-37	"	"	"	"	"	"	917.0	631.5	631.5	631.5	631.5	923.8	1519.8	"
1937-38	"	"	"	"	"	"	709.8	283.6	236.8	236.8	286.0	719.5	1545.0	"
1938-39	"	"	"	"	"	"	697.5	266.7	213.3	213.3	273.8	826.2	1366.7	"
1939-40	"	"	"	"	"	"	736.7	309.5	272.6	272.6	272.6	747.9	1425.6	"
1940-41	"	"	"	"	"	"	842.6	489.6	489.6	489.6	529.2	910.1	1516.4	"
1941-42	"	"	"	"	"	"	797.8	405.2	404.4	404.4	404.4	774.8	1323.4	"
1942-43	"	"	"	"	"	"	805.7	419.3	419.3	419.3	419.3	591.8	1086.0	"
1943-44	"	"	"	"	"	"	1009.2	800.5	800.5	800.5	800.5	1077.5	1644.4	"
1944-45	"	"	"	"	"	"	933.4	662.3	662.3	662.3	662.3	963.5	1599.1	"
1945-46	"	"	"	"	"	"	669.6	228.0	160.3	160.3	179.1	799.5	1657.8	"
1946-47	"	"	"	"	"	"	"	"	"	"	204.3	768.2	1560.7	"
1947-48	"	"	"	"	"	"	678.4	"	"	"	160.3	611.4	1610.8	"
1948-49	"	"	"	"	"	"	900.3	599.4	599.4	599.4	646.6	1187.8	1726.8	"
1949-50	"	"	"	"	"	"	669.6	228.0	160.3	160.3	160.3	443.8	1307.0	"
1950-51	"	"	"	"	"	"	"	"	"	"	"	1291.3	1483.9	"
1951-52	"	"	"	"	"	"	678.4	"	"	"	233.9	722.7	1455.7	"
1952-53	"	"	"	"	"	"	669.6	"	"	"	160.3	460.9	1197.4	"
1953-54	"	"	"	"	"	"	"	"	"	"	"	464.1	1065.7	1686.2
1954-55	"	"	"	"	"	"	"	"	"	"	"	177.6	1064.3	1700.1
1955-56	"	"	"	"	"	"	678.4	"	"	"	"	785.4	1557.5	1726.8
1956-57	"	"	"	"	"	"	669.6	"	"	"	175.9	921.6	1692.3	"
1957-58	"	"	"	"	"	"	"	"	"	"	160.3	818.1	1672.0	"

TABLE 10M
(Metric Units)
COMPOSITE OPERATING RULE CURVES
FOR THE WHOLE OF CANADIAN TREATY STORAGE
END OF PERIOD TREATY STORAGE CONTENTS (hm^3)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7481.2	4555.1	3835.8	4108.1	4703.1	9546.9	16494.5	19119.2
1929-30	"	"	"	"	"	"	5058.6	3795.4	2898.5	3146.6	4224.8	9546.9	15974.1	"
1930-31	"	"	"	"	"	"	5690.1	4450.1	3541.5	3735.7	4652.0	9546.9	16024.5	"
1931-32	"	"	"	"	"	"	2132.2	1276.4	878.1	884.7	1254.1	7123.5	14738.6	"
1932-33	"	"	"	"	"	"	1991.5	1180.2	997.0	959.6	1687.9	6803.5	13831.9	19080.1
1933-34	"	"	"	"	"	"	1887.3	304.8	103.2	138.5	402.7	7815.9	16074.9	19119.2
1934-35	"	"	"	"	"	"	3374.4	2625.4	2527.1	2754.1	3553.7	8289.1	14660.8	"
1935-36	"	"	"	"	"	"	3084.9	2065.9	1837.6	1730.7	2458.6	8442.7	16106.9	"
1936-37	"	"	"	"	"	"	7481.2	4555.1	3835.8	4108.1	4703.1	9546.9	16717.1	"
1937-38	"	"	"	"	"	"	4306.5	3466.3	2629.1	2844.4	3811.8	9294.6	15632.3	"
1938-39	"	"	"	"	"	"	4801.5	4057.9	3111.3	3355.8	4355.9	9546.9	16717.1	"
1939-40	"	"	"	"	"	"	4231.6	3416.4	2592.2	2822.4	3806.9	9403.3	16195.5	"
1940-41	"	"	"	"	"	"	5980.7	4555.1	3835.8	4108.1	4703.1	9546.9	16717.1	"
1941-42	"	"	"	"	"	"	5703.3	4555.1	3835.8	4021.7	4703.1	9451.0	15074.7	"
1942-43	"	"	"	"	"	"	6225.9	4555.1	3835.8	4108.1	4703.1	9514.1	16506.2	"
1943-44	"	"	"	"	"	"	7481.2	4555.1	3835.8	4108.1	4703.1	9546.9	16717.1	"
1944-45	"	"	"	"	"	"	7481.2	4555.1	3835.8	4108.1	4703.1	9546.9	16717.1	"
1945-46	"	"	"	"	"	"	1887.3	507.7	98.4	55.0	822.8	6548.6	15061.3	"
1946-47	"	"	"	"	"	"	2836.3	1829.8	1449.6	1656.6	2639.1	8321.4	15499.0	"
1947-48	"	"	"	"	"	"	2297.1	1340.2	1174.6	1030.8	1720.7	7117.2	15075.7	"
1948-49	"	"	"	"	"	"	7456.7	4555.1	3835.8	4108.1	4703.1	9546.9	16717.1	"
1949-50	"	"	"	"	"	"	2895.8	1885.6	1754.0	1700.9	2465.2	7339.6	13195.7	"
1950-51	"	"	"	"	"	"	3617.8	2806.0	2127.3	2324.8	3303.4	8542.1	15778.6	"
1951-52	"	"	"	"	"	"	4695.3	3736.4	3117.9	3256.9	4198.4	9509.9	16158.6	"
1952-53	"	"	"	"	"	"	5751.7	4438.1	3700.0	3958.8	4526.2	8701.1	15929.1	"
1953-54	"	"	"	"	"	"	1887.3	512.3	178.4	168.1	510.9	5750.7	13193.3	19078.6
1954-55	"	"	"	"	"	"	3860.5	3112.1	2969.7	2983.1	3798.1	8085.5	13838.0	19062.2
1955-56	"	"	"	"	"	"	2087.2	1264.6	920.7	861.2	1665.6	7561.2	15223.0	19119.2
1956-57	"	"	"	"	"	"	2609.1	1660.5	1522.8	1471.1	2329.2	7542.6	16449.5	"
1957-58	"	"	"	"	"	"	2092.8	1284.2	930.2	936.1	1902.0	7215.8	15594.9	"

TABLE 11M
(Metric Units)
COMPOSITE END STORAGE
FOR THE WHOLE OF CANADIAN STORAGE
END OF PERIOD TREATY STORAGE CONTENTS (hm^3)
2016 - 17 ASSURED OPERATING PLAN

YEAR	AUG15	AUG31	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR15	APR30	MAY	JUN	JUL
1928-29	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7481.2	3754.3	2757.3	2506.5	2525.6	6183.8	14645.8	18559.7
1929-30	18925.9	18920.3	17347.6	15151.3	11466.0	8653.9	3332.3	1085.3	3.7	3.2	1409.0	5964.8	12708.9	17588.4
1930-31	18341.9	18766.9	17858.5	15551.8	12048.8	8134.7	3474.7	378.5	0.0	0.0	0.0	3249.1	9757.3	11587.1
1931-32	11505.9	11303.8	9947.4	7440.6	4083.1	695.8	28.4	0.0	6.4	299.5	1132.3	6227.1	14629.9	18624.7
1932-33	19007.9	19119.2	17743.0	15844.7	14844.3	12459.3	7305.8	3319.5	997.0	838.4	1346.4	5666.6	13831.9	18852.5
1933-34	19119.2	19119.2	18714.0	17640.0	15191.9	12640.6	7680.1	3791.5	2250.9	1886.6	3467.6	7815.9	14625.3	18397.9
1934-35	18774.2	18886.8	17257.1	15509.7	15191.9	12459.3	7330.3	3660.1	2527.1	1693.8	2082.5	6576.7	14193.5	18891.7
1935-36	19119.2	19081.5	18418.2	16551.2	13129.9	9484.5	4127.4	1889.3	891.5	654.2	2165.0	8442.7	16106.9	18765.2
1936-37	18915.9	18921.8	17540.9	15454.4	11462.6	7960.0	3007.1	417.1	0.0	0.0	0.0	3648.4	10929.0	14990.1
1937-38	14768.7	14519.1	13143.1	11298.2	9919.5	8188.0	4334.4	3265.7	1585.2	1338.8	1665.9	6259.4	13842.1	18537.4
1938-39	18655.8	18853.0	17986.4	16295.6	13371.9	11158.7	5894.8	4033.5	2645.3	2723.8	3736.9	8810.0	13846.8	18891.7
1939-40	19111.4	18927.9	17379.9	15910.5	13090.5	11296.7	6107.4	3416.4	2592.2	2796.0	3555.4	9403.3	14187.3	17794.1
1940-41	18134.0	18035.1	17186.4	16323.7	13064.4	10078.3	5393.5	3054.1	2475.7	3005.9	4032.0	7291.4	11247.8	13049.9
1941-42	12930.0	12971.9	12709.1	13433.1	11683.7	12008.6	6749.4	4555.1	1941.1	1660.3	1907.1	6088.1	11727.5	17175.1
1942-43	18325.5	18966.8	17862.1	16112.8	14053.3	12459.3	7024.7	4555.1	2498.0	2419.4	2944.0	6226.6	12091.3	17803.9
1943-44	18752.2	19119.2	18514.6	17462.9	14845.0	12409.2	7481.2	4004.1	2654.8	2568.2	2751.2	5774.5	10729.6	11867.0
1944-45	11946.5	11852.3	10576.2	8711.4	5673.9	2301.3	1180.5	137.5	0.0	0.0	0.0	4472.1	11726.3	15579.5
1945-46	15247.0	14995.5	13609.7	12002.8	9983.8	8002.6	2698.8	507.7	0.0	0.0	692.4	6548.6	15061.3	18891.7
1946-47	19119.2	19119.2	18714.0	17553.4	15191.9	12459.3	7103.5	3123.3	1449.6	1510.5	2582.1	8321.4	15499.0	19119.2
1947-48	19119.2	19082.3	18714.0	17640.0	15191.9	12459.3	7180.8	2998.3	1209.8	951.0	1458.2	7117.2	15075.7	19119.2
1948-49	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7456.7	4555.1	3592.6	3406.9	3644.7	9546.9	14962.4	17500.3
1949-50	18462.5	18801.4	17416.6	15877.9	14548.5	12459.3	7099.3	3053.1	1754.0	1597.9	1798.7	5022.4	12121.2	19119.2
1950-51	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7488.1	3530.7	2287.6	2343.4	2809.7	8542.1	15274.4	19119.2
1951-52	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7102.0	3736.4	2713.5	2552.3	3692.7	9233.7	15880.4	18891.7
1952-53	19119.2	19060.0	18157.2	16377.3	13036.2	10153.9	5957.0	4438.1	2362.2	1927.4	2091.4	5596.6	13402.0	18071.1
1953-54	18752.2	19119.2	18714.0	17640.0	15191.9	12459.3	7247.1	3449.5	1330.5	685.0	510.9	5750.7	13109.1	19078.6
1954-55	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7364.3	3464.9	2448.1	2367.1	1716.0	4607.2	12898.0	19062.2
1955-56	19119.2	19119.2	18714.0	17640.0	15191.9	12459.3	7423.0	3181.6	1053.0	861.2	1665.6	7561.2	15223.0	18891.7
1956-57	19027.0	19119.2	18714.0	17640.0	15191.9	12459.3	7151.4	3156.8	1522.8	1444.2	1897.1	7542.6	16227.1	18891.7
1957-58	18784.3	18915.6	17796.6	16674.6	14170.2	12324.3	7088.3	3220.5	930.2	936.1	1393.1	7215.8	15594.9	18891.7
Max	19119.2	19119.2	18714.0	17640.0	15191.9	12640.6	7680.1	4555.1	3592.6	3406.9	4032.0	9546.9	16227.1	19119.2
Median	18920.9	19013.4	17924.3	16350.5	14359.3	12434.2	7393.8	3292.6	1669.6	1554.2	1902.1	6404.0	14017.1	18695.0
Average	17956.0	18009.7	17143.5	15731.3	13226.0	10664.0	5876.4	2924.4	1616.0	1499.3	2022.4	6690.2	13705.2	17720.1
Min	11505.9	11303.8	9947.4	7440.6	4083.1	695.8	28.4	0.0	0.0	0.0	0.0	3249.1	9757.3	11587.1

TABLE 12M
(Metric Units)
COMPARISON OF RECENT ASSURED OPERATING PLAN STUDIES

	2009-10	2010-11	2011-12 through 2013-14 1/	2014-15	2015-16 through 2016-17 3/
MICA TARGET OPERATION (hm^3 or m^3/s)					
AUG 15	8451.0	8414.3	8230.9	8267.6	8267.6
AUG 31	FULL	FULL	FULL	FULL	FULL
SEP	FULL	FULL	FULL	FULL	FULL
OCT	8387.9	8387.9	8387.9	8387.9	8328.5
NOV	622.97	594.65	594.65	622.97	594.65
DEC	707.92	707.92	707.92	622.97	481.39
JAN	651.29	764.55	679.60	679.60	679.60
FEB	566.34	594.65	594.65	594.65	736.24
MAR	481.39	594.65	481.39	707.92	707.92
APR 15	509.70	622.97	566.34	481.39	594.65
APR 30	311.49	283.17	283.17	283.17	283.17
MAY	283.17	226.53	226.53	226.53	226.53
JUN	283.17	226.53	226.53	283.17	226.53
JUL	8407.0	8482.9	8482.9	8482.9	8407.0
COMPOSITE CRC1 CANADIAN TREATY STORAGE CONTENT (hm3)					
1928 AUG 31	19111.9	19069.0	19118.7	19119.2	19119.2
1928 DEC	12503.3	12443.4	12732.1	12923.2	12459.3
1929 APR15	1642.9	2564.5	2653.1	2637.9	2506.5
1929 JUL	17539.4	17696.7	17933.1	18351.7	18559.7
COMPOSITE CANADIAN TREATY STORAGE CONTENT (hm3)					
Pre AOP15: 60-Yr Avg, AOP15 -17: 70-Yr Avg 2/					
AUG 31	18240.6	18197.7	18013.8	18121.4	18142.2
DEC	11353.0	11286.0	11327.8	11363.5	10985.4
APR15	2147.6	2061.6	2222.9	2175.9	1752.6
JUL	17805.4	17784.1	17486.1	17811.0	17869.5
STEP I GAINS AND LOSSES DUE TO REOPERATION (MW)					
U.S. Firm Energy	-0.3	-0.3	0.1	0.0	0.0
U.S. Dependable Peaking Capacity	-2.7	-19.1	-22.9	-3.9	-2.1
U.S. Average Annual Usable Secondary Energy	13.8	16.0	21.6	21.3	17.6
BCH Firm Energy	50.2	34.4	43.6	44.0	24.0
BCH Dependable Peaking Capacity	44.9	43.8	41.7	47.8	28.2
BCH Average Annual Usable Secondary Energy	-28.2	-20.8	-13.9	-33.4	-16.2
COORDINATED HYDRO MODEL LOAD (MW)					
AUG 15	11138	11138	10969	11187	11367
AUG 31	11166	11167	11104	10971	10944
SEP	10850	11025	11081	9756	9822
OCT	9783	9958	9920	9758	10051
NOV	11157	11333	11458	11821	12152
DEC	13193	13369	13316	13836	13744
JAN	13076	13076	12878	13323	13933
FEB	11901	11902	11721	13179	12876
MAR	11316	10967	10501	12022	11269
APR 15	10590	10241	9786	10476	10894
APR 30	12823	12475	11502	11012	11600
MAY	13491	13493	13287	12198	12166
JUN	14079	14080	13867	12208	11291
JUL	12724	12725	12531	11954	11812
ANNUAL AVERAGE	12038	12039	11856	11819	11794

1/ The AOP 2013-14 and 2012-13 utilize the same system regulation study as the 2011-12.

2/ Prior to AOP15, average content based on 60 years of modified flows. AOP15 through AOP17 averages based on 70 years of modified flows.

3/ The AOP 2016-17 utilizes the same Step 1 system regulation studies as used in the AOP 2015-16.

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Project Name (Number)	Constraint Type	Requirements English	Requirements Metric	Explanation	Source
Canadian Projects					
Mica (1890)	Minimum Flow	3000 cfs	85.0 m^3/s		In place in AOP79, AOP80, AOP84.
Arrow (1831)	Minimum Flow	5000 cfs	141.6 m^3/s		In place in AOP79, AOP80, AOP84.
	Draft Rate Limit	1.0 ft/day	0.30 m/day		
Duncan (1681)	Minimum Flow	100 cfs	2.8 m^3/s		In place in AOP79, AOP80, AOP84.
	Maximum Flow	10000 cfs	283.2 m^3/s		
	Draft Rate Limit	1.0 ft/day	0.30 m/day		
	Other			Operate to meet IJC orders for Corra Linn.	CRTOC agreement on procedures to implement 1938 IJC order.
Base System					
Hungry Horse (1530)	Minimum Flow	400 cfs	11.3 m^3/s	Minimum project discharge.	In place in AOP79, AOP80, AOP84.
	Maximum Flow			None	
	Minimum Content			None	
	Other			No VECC limit.	VECC limit not in place in AOP79.
Kerr (1510)	Minimum Flow	1500 cfs	42.5 m^3/s	All periods	In place in AOP80, AOP84.
	Maximum Flow			None	
	Minimum Content	614.7 ksfd 2893.0 ft	1503.9 hm^3 881.79 m	Jun - Sep	MPC 2-1-92, PNCA submittal similar operation, Jun-Aug 15, in AOP80.
		426.3 ksfd 2890.0 ft	1043 hm^3 880.9 m	May	
		0.0 ksfd 2883.0 ft	0 hm^3 878.74 m	Empty Apr 15	FERC, AOP80.
	Maximum Content	58.6 ksfd 2884.0 ft	143.37 hm^3 879.04 m	March (Included to help meet the Apr 15 FERC requirement.)	In place in AOP80, AOP84.
	Other	0.0 ksfd 2883.0 ft	0 hm^3 878.74 m	Conditions permitted, should be on or about, empty Mar and Apr 15.	FERC, AOP80.
Thompson Falls (1490)				None Noted	

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Project Name (Number)	Constraint Type	Requirements English	Requirements Metric	Explanation	Source
Noxon Rapids (1480)	Minimum Content				
	For Step I:	116.3 ksfd 2331.0 ft	284.54 hm^3 710.49 m	May - Aug 31,	In place in AOP84, similar operation in AOP80.
		112.3 ksfd 2330.0 ft	274.75 hm^3 710.18 m	Sep - Jan,	
		78.7 ksfd 2321.0 ft	192.55 hm^3 707.44 m	Feb,	
		26.5 ksfd 2305.0 ft	64.834 hm^3 702.56 m	Mar,	
		0.0 ksfd 2295.0 ft	0 hm^3 699.52 m	Empty Apr 15, Apr 30, and for end of CP.	
	Minimum & Maximum Content				
	For Steps II & III:	116.3 ksfd 2331.0 ft	284.54 hm^3 710.49 m	All periods	In place in AOP79, AOP84.
Cabinet Gorge (1475)				None Noted	
Albeni Falls (1465)	Minimum Flow	4000 cfs	113.3 m^3/s	All periods	In place in AOP80, AOP84.
	Minimum Content	(Dec may fill on restriction, note below)			
		582.4 ksfd 2062.5 ft	1424.9 hm^3 628.65 m	Jun - Aug 31	In place in AOP80, AOP84.
		465.7 ksfd 2060.0 ft	1139.4 hm^3 627.89 m	Sep	
		190.4 ksfd 2054.0 ft	465.83 hm^3 626.06 m	Oct	
		57.6 ksfd 2051.0 ft	140.92 hm^3 625.14 m	Nov-Apr 15	
		190.4 ksfd 2054.0 ft	465.83 hm^3 626.06 m	Apr 30 (empty at end of CP)	
		279.0 ksfd 2056.0 ft	682.59 hm^3 626.67 m	May	
	For Steps I & II:	Optimum to run CP & LT to Jun-Oct SMINs.			
	For Step III:	Keep full at beginning of CP. Often (not always) optimum to run higher than SMIN in CP & LT (except when occasionally drafting below SMIN to meet load).			
		57.6 ksfd 2051.0 ft	140.9 hm^3 625.14 m	Nov - Mar	
		458.4 ksfd 2059.8 ft	1121.5 hm^3 627.8 m	May	
		582.4 ksfd 2062.5 ft	1424.9 hm^3 628.7 m	Sep	
		465.7 ksfd 2060.0 ft	1139.4 hm^3 627.89 m	Oct	

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Albeni Falls (1465) (Continued)	Kokanee Spawning	1.0 ft	0.30 m	Draft limit below Nov. 20th Elevation through Dec. 31st.	In place before AOP80 and supported by minimum contents noted above.
		0.5 ft	0.15 m	If project fills, draft no more than this amount.	
				Dec. 31 - Mar 31, operate between SMIN and URC within above noted draft limits.	
	Other Spill	50 cfs	1.4 m^3/s	All periods	
Grand Coulee (1280)	Minimum Flow	30000 cfs	849.5 m^3/s	All periods	In place in AOP79, AOP80, AOP84.
	Minimum Content	0.0 ksfd 1208.0 ft	0.0 hm^3 368.20 m	Empty at end of CP.	
	Step I only:	843.7 ksfd 1240.0 ft	2064.2 hm^3 377.95 m	May and June	Retain as a power operation (for pumping).
	Steps II & III only:	868.8 ksfd 1240.0 ft	2125.6 hm^3 378.0 m	May and June	
	Maximum Content				
	Step I only:	2.0 ft	0.61 m	Operating room Sep - Nov	In place in AOP89
		3.0 ft	0.91 m	Operating room Dec - Feb	Retain as a power operation.
	Steps II & III only:	2557.1 ksfd 1288.0 ft	6256.1 hm^3 392.58 m	Aug-Nov	
		2518.3 ksfd 1287.0 ft	6161.2 hm^3 392.28 m	Dec-Feb	
	Draft Rate Limit	1.3 ft/day	0.40 m/day	(bank sloughage)	
		1.5 ft/day	0.46 m/day	(Constraint submitted as 1.5 ft/day interpreted as 1.3 ft/day mo.ave.)	
Chief Joseph (1270)	Other Spill	500 cfs	14.2 m^3/s	All periods	
Wells (1220)	Other Spill	1000 cfs	28.3 m^3/s	All periods	2/1/05 C. Wagers, Douglas With fish ladder
	Fish Spill			None	
Rocky Reach (1200)	Fish Spill/Bypass			None	
	Other Spill	200 cfs	5.7 m^3/s	Aug 31 - Apr 15 (leakage)	
Rock Island (1170)	Fish Spill/Bypass			None	
Wanapum (1165)	Fish Spill/Bypass			None	
	Other Spill	2200 cfs	62.3 m^3/s	All periods	With fish ladder
Priest Rapids (1160)	Minimum Flow			Limit removed	
	Fish Spill/Bypass			None	
	Other Spill	2200 cfs	62.3 m^3/s	All periods	With fish ladder

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Project Name (Number)	Constraint Type	Requirements English	Metric	Explanation	Source
Brownlee (767)	Minimum Flow	5850 cfs	165.7 m^3/s	All years, all periods in CP & LT studies.	4-04 C. Henriksen
	Downstream Minimum Flow	13000 cfs	368.1 m^3/s	July-Sep in all years for navigation requirement downstream at Lime Point (project #760). Draft Brownlee to help meet this requirement in CP and LT studies.	4-04 C. Henriksen
	Power Operation			Agree to use “old” power operation (first codes) provided by IPC and used in AOP since AOP97 for CP.	2-1-91 PNCA submittal
				LT run to PDP using rule curves from CP with BECC created from regulation spreadsheet to meet flow requirements at Lime Pt., and Brownlee and mimic the "old" historic first code operation on a 60 year average and median comparison. Consistent w/ TSR.	7-00 J. Hyde
Oxbow (765)	Other Spill	100 cfs	2.8 m^3/s	All periods	
Ice Harbor (502)	Fish Spill/Bypass			None	
	Other Spill	740 cfs	21.0 m^3/s	All periods	
	Incremental Spill			None	
	Minimum Flow			None	
	Other	204.8 ksfd 440.0 ft	83.7 hm^3 134.11 m	Run at all periods	
McNary (488)	Other Spill	3475 cfs	98.4 m^3/s	All periods	
	Incremental Spill			None	
John Day (440)	Fish Spill/Bypass			None	
	Other Spill	800 cfs	22.7 m^3/s	All periods	
	Incremental Spill			None	
	Minimum Flow	50000 cfs	1415.8 m^3/s	Mar - Nov	
		12500 cfs	354.0 m^3/s	Dec - Feb	
	Other Step I:	269.7 ksfd 268.0 ft	659.8 hm^3 81.69 m	June - Aug 15	In place AOP80
		242.5 ksfd 267.0 ft	593.3 hm^3 81.38 m	Aug 31 - Sep	
		153.7 ksfd 263.6 ft	376.0 hm^3 80.35 m	Oct - Mar	
		114.9 ksfd 262.0 ft	281.1 hm^3 79.86 m	Apr - May	
	Steps II & III:	190.0 ksfd 265.0 ft	464.8 hm^3 80.77 m	Use JDA as run-of-river plant.	

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Project Name (Number)	Constraint Type	Requirements English	Metric	Explanation	Source
The Dalles (365)	Fish Spill/Bypass			None	
	Other Spill	1300 cfs	36.8 m^3/s	All periods	
	Incremental Spill			None	
	Minimum Flow	50000 cfs	1415.8 m^3/s	Mar - Nov	
		12500 cfs	354.0 m^3/s	Dec - Feb	
Bonneville (320)	Fish Spill/Bypass			None	
	Other Spill	8040 cfs	227.7 m^3/s	All periods	
	Incremental Spill			None	
Kootenay Lake (Corra Linn (1665))	Minimum Flow	5000 cfs	141.6 m^3/s	All periods	BCHydro agreements 1969.
	Other			Operate to IJC orders.	CRTOC agreement on procedures to implement 1938 IJC order.
Chelan (1210)	Minimum Flow	50 cfs	1.4 m^3/s	All periods	In place in AOP79, AOP80, AOP84
	Minimum Content	308.5 ksfd 1098.0 ft	126.1 hm^3 334.7 m	Jul - Sep (except as needed to empty at end of critical period).	In place in AOP79, AOP80, AOP84
Couer d'Alene L (1341)	Minimum Flow	50 cfs	1.4 m^3/s	All periods	In place in AOP79.
	Minimum Content	112.5 ksfd 2128.0 ft	275.2 hm^3 648.6 m	May - Aug Flood control may override these minimum contents.	2-1-00 PNCA submittal
Post Falls (1340)	Minimum Flow	50 cfs	1.4 m^3/s	All periods	In place in AOP79, AOP80, AOP84.
Other Major Step I Projects					
Libby (1760)	Minimum Flow	4000 cfs	113.3 m^3/s	All periods	
	Other Spill	200 cfs	5.7 m^3/s	All periods	
	Minimum Content	By contract year: Aug-Jul i.e., 1929 = Aug 1928 - Jul 1929			
		776.9 ksfd 2363.0 ft	1900.7 hm^3 720.24 m	1929 Dec	2-1-93 PNCA submittal, in place in AOP99.
		676.5 ksfd 2355.0 ft	1655.1 hm^3 717.80 m	1929 Jan	
		603.6 ksfd 2349.0 ft	1476.8 hm^3 715.98 m	1929 Feb	
		2147.7 ksfd 2443.0 ft	5254.5 hm^3 744.63 m	1929 Jul	
		652.0 ksfd 2353.0 ft	1595.2 hm^3 717.19 m	1930 Dec	
		433.2 ksfd 2334.0 ft	1059.9 hm^3 711.40 m	1930 Jan	
		389.3 ksfd 2330.0 ft	952.5 hm^3 710.18 m	1930 Feb	
		348.5 ksfd 2326.0 ft	852.6 hm^3 708.96 m	1930 Mar	
		297.4 ksfd 2321.0 ft	727.6 hm^3 707.44 m	1930 Apr 15	

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Project Name (Number)	Constraint Type	Requirements English	Metric	Explanation	Source
Libby (1760) (Continued)		444.2 ksfd 2335.0 ft	1086.8 hm^3 711.71 m	1930 Apr 30	
		499.1 ksfd 2340.0 ft	1221.1 hm^3 713.23 m	1930 May	
		1344.6 ksfd 2402.0 ft	3289.7 hm^3 732.13 m	1930 Jun	
		1771.9 ksfd 2425.0 ft	4335.1 hm^3 739.14 m	1930 Jul	
		317.8 ksfd 2323.0 ft	777.5 hm^3 708.05 m	1931 Dec	
		192.2 ksfd 2310.0 ft	470.2 hm^3 704.09 m	1931 Jan	
		103.1 ksfd 2300.0 ft	252.2 hm^3 701.04 m	1931 Feb-Apr 30	
		192.2 ksfd 2310.0 ft	470.2 hm^3 704.09 m	1931 May	
		676.5 ksfd 2355.0 ft	1655.1 hm^3 717.80 m	1931 Jun	
		868.0 ksfd 2370.0 ft	2123.6 hm^3 722.38 m	1931 Jul	
		174.4 ksfd 2308.0 ft	426.7 hm^3 703.48 m	1932 Dec	
		103.1 ksfd 2300.0 ft	252.2 hm^3 701.04 m	1932 Jan	
		0.0 ksfd 2287.0 ft	0.0 hm^3 697.08 m	Empty at end of CP***	
		776.9 ksfd 2363.0 ft	1900.7 hm^3 720.24 m	All Dec	
		373.1 ksfd	152.5 hm^3	July 1930 - No more than this amount lower than July 1929.	2-1-94 PNCA submittal, in place in AOP00 and AOP01.
		857.1 ksfd	350.3 hm^3	July 1931 - No more than this amount lower than July 1930.	
		March - Implement PNCA 6(c)2(c).			
	Max Summer Draft	5.0 ft	1.52 m		
	Other			Operate to meet IJC orders for Corra Linn.	CRTOC agreement on procedures to implement 1938 IJC order.
Dworshak (535)	Minimum Flow	1500 cfs	42.5 m^3/s	All periods	2-1-10 PNCA submittal through powerhouse
	Maximum Flow	14000 cfs	396.4 m^3/s	All periods (model includes maximum 14000 cfs for all periods, but URC may override.)	2-11-02 PNCA submittal
		25000 cfs	707.9 m^3/s	Up to 25 kcfs for flood control all periods.	
	Minimum Content	395.8 ksfd	968.4 hm^3	SMIN Apr - Aug 31	
	Start 3 yr CP at:	395.8 ksfd	968.4 hm^3	Aug 15	
	End 3 yr CP at:	218.4 ksfd	534.3 hm^3	Feb	

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Project Name (Number)	Constraint Type	Requirements English	Metric	Explanation	Source
Dworshak (535) (Continued)	Other	Run on minimum flow or flood control observing maximum & minimum flow requirements Oct-May and meets target operation Jun-Sep to obtain uniform ouflows Jul-Aug			2-1-05 PNCA submittal
	Target Operation:				
		782.6 ksfd 1573.6 ft	1914.7 hm^3 479.63 m	Jul	2-1-10 PNCA submittal (2011)
		658.5 ksfd 1557.6 ft	1611.1 hm^3 474.76 m	Aug 15	for Jul-Aug 15 and Sep based use 70 yr Median .
		497 ksfd 1535 ft	1215.9 hm^3 467.87 m	Aug 31	
		390.7 ksfd 1519.2 ft	955.88 hm^3 463.05 m	Sep	
		1016 ksfd 1600 ft	2485.7 hm^3 487.68 m	Jun	
	Other Spill	100 cfs	2.8 m^3/s	All periods	
Lower Granite (520)	Bypass Date			None	
	Other Spill	450 cfs	12.7 m^3/s	Jul	2-1-09 PNCA submittal
		510 cfs	14.4 m^3/s	15-Aug	
		470 cfs	13.3 m^3/s	30-Aug	
		480 cfs	13.6 m^3/s	Sep	
		530 cfs	15.0 m^3/s	Oct	
		410 cfs	11.6 m^3/s	Nov	
		340 cfs	9.6 m^3/s	Dec	
		100 cfs	2.8 m^3/s	Jan	
		130 cfs	3.7 m^3/s	Feb	
		230 cfs	6.5 m^3/s	Mar	
		420 cfs	11.9 m^3/s	15-Apr	
		440 cfs	12.5 m^3/s	Apr 30 - May	
		460 cfs	13.0 m^3/s	Jun	
	Incremental Spill			Removed	
	Fish Spill				
		17333 cfs	490.8 m^3/s	Apr 15 [20 kcfs for 13 days]	2-1-10 PNCA submittal
		20000 cfs	566.3 m^3/s	Apr 30 [20 kcfs]	2-1-10 PNCA submittal
		10968 cfs	310.6 m^3/s	May spill 1 - 6 and 21 - 31 at 20000	2-1-10 PNCA submittal
		18000 cfs	509.7 m^3/s	Jun - Aug 15	
	Maximum Fish Spill	20000 cfs	566.3 m^3/s	Apr 15 - May	
		18000 cfs	509.7 m^3/s	Jun - Aug 15	
	Minimum Flow	11500 cfs	325.6 m^3/s	All periods	
	Other	224.9 ksfd 733 ft	550.2 hm^3 223.42 m	On MOP Apr - Oct 31. On MOP Apr - Oct 31.	
		245.8 ksfd 738 ft	601.4 hm^3 224.94 m	On full pool Nov 30 - Mar 31. On full pool Nov 30 - Mar 31.	

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Project Name (Number)	Constraint Type	Requirements English	Metric	Explanation	Source
Little Goose (518)	Bypass Date			None	
	Other Spill	590 cfs	16.7 m^3/s	Jul	2-1-09 PNCA submittal
		620 cfs	17.6 m^3/s	15-Aug	
		500 cfs	14.2 m^3/s	30-Aug	
		750 cfs	21.2 m^3/s	Sep	
		640 cfs	18.1 m^3/s	Oct	
		500 cfs	14.2 m^3/s	Nov	
		460 cfs	13.0 m^3/s	Dec	
		120 cfs	3.4 m^3/s	Jan	
		240 cfs	6.8 m^3/s	Feb	
		380 cfs	10.8 m^3/s	Mar	
		530 cfs	15.0 m^3/s	15-Apr	
		580 cfs	16.4 m^3/s	Apr 30 - May	
		660 cfs	18.7 m^3/s	May	
		590 cfs	16.7 m^3/s	Jun	
	Incremental Spill			Removed	
	Fish Spill (% of outflow)	22%		Apr 15 [30%*11/15]	2-1-09 PNCA submittal
		30%		Apr 30	2010 data submittial
		16%		May spill 30% May 1 - 6 and May 21 - 31	2010 data submittial
		30%		Jun - Aug 15	
	Maximum Fish Spill	30000 cfs	849.5 m^3/s	Apr 15 - Apr 31	
		28000 cfs	792.9 m^3/s	May	
		30000 cfs	849.5 m^3/s	Jun	
		28000 cfs	792.9 m^3/s	Jul - Aug 15	
	Minimum Flow	11500 cfs	325.6 m^3/s	All periods	
	Other	260.5 ksfd 633 ft	106.5 hm^3 192.94 m	On MOP Apr - Aug 31.	
		285.0 ksfd 638 ft	697.3 hm^3 194.46 m	On full pool Sep 30 - Mar 31.	
Lower Monumental (504)	Bypass Date			A bypass date of 2010 was assumed.	
	Other Spill	790 cfs	22.4 m^3/s	Jul	2-1-09 PNCA submittal
		860 cfs	24.4 m^3/s	15-Aug	
		770 cfs	21.8 m^3/s	30-Aug	
		780 cfs	22.1 m^3/s	Sep	
		840 cfs	23.8 m^3/s	Oct	
		750 cfs	21.2 m^3/s	Nov	
		720 cfs	20.4 m^3/s	Dec	
		450 cfs	12.7 m^3/s	Jan	
		410 cfs	11.6 m^3/s	Feb	
		560 cfs	15.9 m^3/s	Mar	

Appendix A
Project Operating Procedures for the 2016-17
Assured Operating Plan and Determination of Downstream Power Benefits

Project Name (Number)	Constraint Type	Requirements English	Metric	Explanation	Source
Lower Monumental		770 cfs	21.8 m^3/s	15-Apr	
(504) - (Continued)		780 cfs	22.1 m^3/s	Apr 30 - May	
		840 cfs	23.8 m^3/s	May	
		780 cfs	22.1 m^3/s	Jun	
	Fish Spill	15600 cfs	441.7 m^3/s	Apr 15 [26000*(9/15)]	2-1-09 PNCA submittal
		25000 cfs	707.9 m^3/s	Apr 31	
		12065 cfs	341.6 m^3/s	May spill 22000 May 1 - 6 and May 21 - 31	2010 data submittial
		17000 cfs	481.4 m^3/s	Jun - Aug 15	
	Maximum Fish Spill	26000 cfs	736.2 m^3/s	Apr 15	
		25000 cfs	707.9 m^3/s	Apr 30	
		22000 cfs	623.0 m^3/s	May	
		17000 cfs	481.4 m^3/s	Jun - Aug 15	
	Minimum Flow	11500 cfs	325.6 m^3/s	All period	
	Other	180.5 ksfd 537 ft	441.6 hm^3 163.68 m	On MOP Apr - Aug 31.	
		190.1 ksfd 540 ft	465.1 hm^3 164.59 m	On full pool Sep 30 - Mar 31.	
Cushman (2206)	Other Spill	240 cfs	6.8 m^3/s	All periods	2-1-09 PNCA submittal
LaGrande (2188)	Other Spill	30 cfs	0.8 m^3/s	All periods	
White River (2160)	Other Spill	130 cfs	3.7 m^3/s	All periods	
Lower Baker (2025)	Max Storage Limits	67.0 ksfd 442.4 ft	163.9 hm^3 134.84 m	Jul - Aug 31	2-1-05 PNCA submittal
		40.1 ksfd 415.9 ft	98.1 hm^3 126.77 m	Sep	
		34.7 ksfd 409.8 ft	84.9 hm^3 124.91 m	Oct - Dec	
		45.2 ksfd 421.4 ft	110.6 hm^3 128.44 m	Jan - Mar	
		46.7 ksfd 423.0 ft	114.3 hm^3 128.93 m	Apr 15	
		67.0 ksfd 442.4 ft	163.9 hm^3 134.84 m	Apr 30 - Jun	
	Min Storage Limit	11.2 ksfd 378.8 ft	27.4 hm^3 115.46 m	All periods	
Upper Baker (2028)	Max Storage Limits	107.4 ksfd 727.8 ft	262.8 hm^3 221.83 m	Jul - Sep	2-1-05 PNCA submittal
		82.3 ksfd 717.0 ft	201.4 hm^3 218.54 m	Oct	
		70.9 ksfd 711.7 ft	173.5 hm^3 216.93 m	Nov - Feb	
		107.4 ksfd 727.8 ft	262.8 hm^3 221.83 m	Mar - Jun	

Appendix A
Project Operating Procedures for the 2016-17
Assured Operating Plan and Determination of Downstream Power Benefits

Project Name (Number)	Constraint Type	Requirements English	Requirements Metric	Explanation	Source
Upper Baker (2028) (Continued)	Min Storage Limits	69.3 ksfd 710.8 ft	169.5 hm^3 216.65 m	Jul - Aug 31	
		65.6 ksfd 708.8 ft	160.5 hm^3 216.04 m	Sep - Oct	
		16.6 ksfd 677.8 ft	40.6 hm^3 206.59 m	Nov - Mar	
		38.0 ksfd 693.8 ft	93.0 hm^3 211.47 m	Apr 15 - Apr 30	
		69.3 ksfd 710.8 ft	169.5 hm^3 216.65 m	May - Jun	
Timothy (117)	Minimum Content	24.5 ksfd 3180.0 ft	59.9 hm^3 969.26 m	Oct - May	3-6-01 PNCA submittal
		31.1 ksfd 3190.0 ft	76.1 hm^3 972.31 m	Jun - Aug 31	
		27.8 ksfd 3185.0 ft	68.0 hm^3 970.79 m	Sep	
Long Lake (1305)	Minimum Content	50.1 ksfd 1535.0 ft	122.6 hm^3 467.87 m	Apr - Nov	2-5-02 PNCA submittal
		19.7 ksfd 1522.0 ft	48.2 hm^3 463.9 m	Dec - Mar	
	Draft Rate Limit	1.0 ft/day	0.30 m/day		2-1-03 PNCA submittal
Priest Lake (1470)	Maximum Content	0.0 ksfd 0.0 ft	0.0 hm^3 0.00 m	Oct	2-1-03 PNCA submittal
	Max/Min Content	35.5 ksfd 3.0 ft	86.9 hm^3 0.91 m	Maintain at or near after runoff through Sep.	
Ross (2070)	Minimum Content/			Dependent on Skagit Fisheries.	2-1-06 PNCA submittal
		Fixed ARCs and VRCs			2-1-10 PNCA submittal
Gorge (2065)	Minimum Flow			Settlement; monthly data, varies by water year.	2-1-06 PNCA submittal

Note: Definition of split months: Apr=Apr.1-30, Apr.15=Apr.1-Apr.15, Apr30=Apr.16-Apr.30; Aug=Aug.1-31, Aug.15=Aug.1-15, Aug.31=Aug.16-31.

COLUMBIA RIVER TREATY
DETERMINATION OF DOWNSTREAM POWER BENEFITS

FOR THE ASSURED OPERATING PLAN
FOR OPERATING YEAR 2016-17

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DETERMINATION OF DOWNSTREAM POWER BENEFITS (DDPB) FOR THE ASSURED OPERATING PLAN FOR OPERATING YEAR 2016-17

November 2011

1. Introduction

The "Treaty between Canada and The United States of America relating to Cooperative Development of The Water Resources of The Columbia River Basin" (Treaty), dated 17 January 1961, requires that downstream power benefits from the operation of the Treaty storage in Canada (Canadian Treaty Storage) to be determined in advance by the two Entities created by the Treaty. The purpose of this document is to describe the results of the Determination of Downstream Power Benefits for operating year 2016-17 (DDPB17).

2. Procedures

The procedures followed in the benefit studies are those provided in Article VII; Annex A, paragraph 7, and Annex B of the Treaty; in paragraphs VIII, IX, and X of the "Protocol - Annex to Exchange of Notes, Dated January 22, 1964 Between the Governments of Canada And the United States Regarding the Columbia River Treaty" (Protocol), and in the following Entity agreements:

- The Entity agreements, signed 28 July and 12 August 1988, on "Principles for the Preparation of the AOP and Determination of Downstream Power Benefit (DDPB) Studies" and "Changes to Procedures for the Preparation of the AOP and DDPB Studies" (1988 Entity Agreements);

- The "Columbia River Treaty Entity Agreement on Resolving the Dispute on Critical Period Determination, the Capacity Entitlement for the 1998-99, 1999-00, and 2000-01 AOP/DDPBs, and Operating Procedures for the 2001-02 and Future AOPs," signed 29 August 1996 (1996 Entity Agreement); and

- Except for the changes noted below, the "Columbia River Treaty Entity Agreement on the Principles and Procedures for Preparing and Implementing Hydroelectric Operating Plans For Operation of Canadian Treaty Storage" (POP), dated October 2003 and signed 16 December 2003, including the September 2011 update to Appendix 1 - Refill Curves, the November 2004 additions of Appendix 6 - Streamline Procedures, and Appendix 7 - Table of Median Stream flows, and the September 2007 addition of Appendix 8 concerning Water Supply Forecasts.

Special terms used in this document, but not defined herein, have the meanings defined in the Treaty, Protocol, or the above Entity agreements. The POP is based on criteria contained in Annex A and Annex B of the Treaty, the Protocol, and the "Columbia River

Treaty Flood Control Operating Plan" (FCOP) dated May 2003. For the DDPB17, the Entities have agreed to use the first and second of the three streamline procedures defined in Appendix 6 of the POP. This consists of "Forecasting Loads and Resources" for determining the thermal installations (described in Subsection 7(d) of the AOP17 document) and "Multi-Year Use of Same Operating Criteria for Canadian Treaty Storage" based on the AOP16 Joint Optimum Step I system regulation study as described in Subsection 2(b) of the AOP17 document.

In addition to the changes discussed in Subsection 2(a) of the AOP17 document, the Entities have agreed to modify the DDPB17 Table 2 calculation of Thermal Displacement Market (TDM), as was done in the DDPB16, to use thermal imports (e.g. market purchases of power from California, but not Canadian Entitlement (CE) or Skagit Treaty power) to support exports (not including CE, plant sales, flow-through-transfers (FTT), seasonal exchanges (SE) or excess extra-regional thermal installations), on an annual basis, as either FTTs or SEs.

The Canadian Entitlement Benefits were computed from the following studies:

Step I -- Operation of the total United States of America (USA) Columbia Basin hydro and thermal system, with 19.12 cubic kilometers[1] (km^3) (15.5 million acre-feet (Maf)) of Canadian Treaty Storage operated for flood control and optimum power generation in both countries including coordination with other generation in Canada and the USA;

Step II -- Operation of the Step I thermal system, the base hydro system, and 19.12 km^3 (15.5 Maf) of Canadian Treaty Storage operated for flood control and optimum power generation in both countries; and

Step III -- Operation of the Step I thermal system and the base hydro system operated for flood control and optimum power generation in the United States.

As part of the DDPB, separate determinations may be carried out relating to the limit of year-to-year reduction in benefits attributable to the operation of Canadian Treaty Storage in operating plans designed to achieve optimum power generation at-site in Canada and downstream in Canada and the USA (Joint Optimum). However, as indicated in Section 4 below, the calculations were not needed for the 2016-17 operating year.

3. Results of Canadian Entitlement Computations

The Canadian Entitlement to the downstream power benefits in the USA attributable to operation in accordance with Treaty Annex A, paragraph 7, for optimum power generation in Canada and the USA, which is one-half the total downstream power benefits, was determined to be (see Joint Optimum results in Table 5):

Dependable Capacity	= 1333.2 megawatts (MW)
Average Annual Usable Energy	= 484.0 average annual MW

All downstream power benefit computations are rounded to the nearest tenth of a MW.

In determining the Canadian Entitlement, studies were developed for the Steps II and III critical period and 30-year hydro regulation studies for optimum generation in the USA alone. Since the AOP17 uses the Streamline Procedure to implement AOP16 Joint Optimum operating criteria, the Entities agreed that the change in the average annual energy gain for Canadian Entitlement due to Canadian storage operation for optimum generation in both Canada and the USA would be the same as in the DDPB16. The DDPB16 Joint Optimum shows a 3.7 aMW increase in the Canadian Entitlement for average annual usable energy. There is no change in the DDPB17 dependable capacity.

4. Computation of Maximum Allowable Reduction in Downstream Power Benefits

Treaty Annex A, paragraph 7, states in part that:

> *". . . Any reduction in the downstream power benefits in the United States of America resulting from that change in operation of the Canadian storage shall not exceed in any one year the reduction in downstream power benefits in the United States of America which would result from reducing by 500,000 acre-feet the Canadian storage operated to achieve optimum power generation in the United States of America and shall not exceed at any time during the period of the Treaty the reduction in downstream power benefits in the United States of America which would result from similarly reducing the Canadian storage by 3,000,000 acre-feet."*

As explained in Section 3 above and as shown in Table 5, the Entities have agreed that optimum power generation in Canada and the USA resulted in a 3.7 average annual megawatt (aMW) increase in the Energy Entitlement compared to the DDPB17 Step II studies based on optimum power generation only in the USA. Given that there is no reduction in the downstream power benefits in the DDPB17, the computation of the maximum allowable reduction in downstream power benefits, as defined in Section 3.3.A(3) of the POP, was not necessary.

5. Delivery of the Canadian Entitlement

See Section 6 of the AOP17.

6. Summary of Information Used for Canadian Entitlement Computations

The following tables and chart summarize the study results:

Table 1A Determination of Step I Firm Energy Hydro Loads
and
Table 1B Determination of Step I Firm Peak Hydro Loads

These tables follow the definition of Step I loads and resources defined by Treaty Annex B, paragraph 7, and clarified by the 1988 Entity Agreements

and modified according to the Streamline Procedures noted in Section 2 of this DDPB and described in Section 7 of the AOP17. Table 1A shows the Step I energy loads and resources while Table 1B shows the Step I peak loads and resources.

Table 2 Determination of Thermal Displacement Market

This table shows the computation of the TDM for the downstream power benefit determination of average annual usable energy. The TDM is the thermal installations shown in Table 1A with subsequent reductions for estimated minimum thermal generation and system sales. System sales are all exports except for Canadian Entitlement, plant sales, seasonal exchanges, and flow-through-transfers, as defined in POP and modified in Section 2 of this DDPB.

Table 3 Determination of Loads for Step II and Step III Studies

This table shows the computation of the Step II and III loads. The monthly loads for Steps II and III studies have the same ratios between each month and the annual average as the PNWA load (to maintain the same annual load shape). The PNWA firm loads were based on the Bonneville Power Administration (BPA) 2010 White Book (WB10) load forecast as described in Subsection 7(a) of the AOP17. The Grand Coulee pumping load is included in this estimate. The method for computing the firm load for the Steps II and III studies is described in the 1988 Entity Agreements and in the POP.

Table 4 Summary of Steps I, II, and III Power Regulations

This table summarizes the results of the Steps I, II, and III power regulation studies for each project and the total system. The determination of the Steps I, II, and III loads and thermal installations is shown in Tables 1 to 3.

Hydro maintenance, transmission losses and peaking reserves (for capacity balance) are summed together in the Step I load-resource balance as a resource adjustment. The Steps II and III capacity balance includes the hydro maintenance and the peaking reserves based on the same percentage as the Step I system.

The firm energy load carrying capability for the Steps I, II, and III Systems is based on the same critical periods as recent studies. The firm peak load carrying capability for each system is based on the period with the least surplus firm peak capability over the thirty water years. For the AOP/DDPB17, these periods are February 1932, January 1938, and February 1931 for the Steps I, II and III systems, respectively.

Table 5 Computation of Canadian Entitlement

A. Joint Optimum Generation in Canada and the USA
B. Optimum Generation in the USA Only

The essential elements used in the computation of the Canadian Entitlement arising from the downstream power benefits under the USA Optimum are shown under Column B. These elements are derived from (1) Steps II and III critical period studies based on loads determined in Table 3, (2) the Thermal Displacement Market from Table 2, and (3) the full Steps II and III 30-year USA Optimum hydro regulation studies. As explained in Section 3, the Joint Optimum studies were not conducted, and hence, the data under Column A is not available. The computation of maximum allowable reduction in downstream power benefits are not shown in this table because that calculation is not necessary (as explained in Section 4).

Table 6 Comparison of Recent DDPB Studies

Chart 1 Duration Curves of 30 Years Monthly Hydro Generation

This chart shows duration curves of the hydro generation in aMW from the USA Optimum Steps II and III system regulation studies[2] which graphically illustrate the change in average annual usable hydro energy. Usable hydro energy consists of firm energy plus usable nonfirm energy. Firm energy is the firm hydro loads shown in Table 5, and nonfirm energy is the monthly hydro energy capability in excess of the firm hydro loads. The usable nonfirm energy is computed in accordance with Annex B, paragraphs 3(b) and 3(c), as the portion of nonfirm energy that can be used to displace thermal installations designated to meet PNWA firm loads, plus the remaining usable energy. The Entities agree that remaining usable energy is computed on the basis of 40 % of the nonfirm energy remaining after thermal displacement.

7. Summary of Changes Compared to the 2015-16 DDPB and Notable Assumptions

Data from recent DDPBs are summarized in Table 6. The following is an explanation of changes and notable assumptions that impact computation of the Entitlement compared to the 2015-16 DDPB (DDPB16) studies.

a) Steps II and III Firm Loads

The Steps II and III hydro firm loads shown on Table 3 are somewhat different from the DDPB16. For DDPB17, the loads are essentially the same for July through January, with the loads from 2016-17 trending lower than those for 2015-16. The substantial difference involves the load shape between February and June, as shown in the table below. This is mainly due to the change in PNWA load shape in February and thermal maintenance schedules in March, the first-half of April, and June, which are explained in Subsection 7(b).

Differences between DDPB17 and DDPB16 Table 3 Hydro Loads

	Aug1	*Aug2*	*Sept*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*15-Apr*	*30-Apr*	*May*	*June*	*July*	*Avg.*	*CPavg*
Ddpb17 S2	**8098**	**8063**	**6875**	**6908**	**8958**	**10606**	**10770**	**9805**	**9218**	**8020**	**8923**	**9961**	**8608**	**9061**	**8944**	**8948**
Ddpb16 S2	**8129**	**8043**	**6934**	**6970**	**8968**	**10630**	**10740**	**9640**	**8900**	**8442**	**8973**	**10033**	**8861**	**9039**	**8962**	**8952**
Difference	**-31**	**21**	**-59**	**-62**	**-10**	**-24**	**31**	**165**	**318**	**-423**	**-50**	**-72**	**-253**	**22**	**-17**	**-3**
Ddpb17 S3	**5552**	**5522**	**4490**	**4522**	**6296**	**7707**	**7855**	**7022**	**6650**	**5582**	**6480**	**7582**	**6122**	**6426**	**6354**	**6975**
Ddpb16 S3	**5640**	**5559**	**4598**	**4629**	**6355**	**7783**	**7884**	**6934**	**6379**	**6049**	**6574**	**7701**	**6424**	**6459**	**6424**	**6982**
Difference	**-88**	**-36**	**-109**	**-106**	**-59**	**-76**	**-29**	**88**	**271**	**-468**	**-95**	**-119**	**-301**	**-33**	**-69**	**-7**

The average critical period load factor increased slightly from 73.93% in AOP16 (Draft WB10) to 74.03% in AOP17 (WB10).

b) Thermal Installations

The total thermal installation energy capability shown in Tables 1 to 3 increased by 332 annual aMW compared to the DDPB16. This is due mainly to a 324 aMW increase in the PNWA firm load, a 10 aMW increase in exports, a 21 aMW increase in imports, and a 9 aMW decrease in the Step I renewable resources (mostly wind), and changes in the thermal maintenance schedules.

Beginning with AOP06, Columbia Generating Station changed from an annual maintenance cycle to a 24 month cycle. This created a circumstance where this maintenance was included only in alternate years of the AOP with a resulting effect of swings in Energy Entitlement. Beginning with AOP/DDPB14 and continuing with this AOP/DDPB, the Entities have agreed to use the average of the two year maintenance schedule, thereby eliminating the year to year Energy Entitlement variability and reducing the effect on the AOP storage operations.

In addition, the thermal installation shape has changed due to changes in thermal maintenance schedules (mostly coal but also combustion turbines and co-generation).

The TDM increased by 337 annual aMW, due to a combination of the changes in thermal installations and system sales. Both the thermal installation and TDM changes are shown in the following table.

DDPB17 minus DDPB16 Table 2 Thermal Installations and Thermal Displacement Market

	Aug1	*Aug2*	*Sept*	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*15-Apr*	*30-Apr*	*May*	*June*	*July*	*Avg.*	*CPavg*
DDPB17 T.I.	**10438**	**10437**	**10490**	**10462**	**10424**	**10503**	**10457**	**10459**	**9477**	**9730**	**8867**	**7362**	**9486**	**10124**	**9911**	**9995**
DDPB16 T.I.	**10055**	**10106**	**10129**	**10135**	**10122**	**10170**	**10126**	**10130**	**9516**	**9040**	**8550**	**7007**	**8945**	**9813**	**9579**	**9662**
Difference	**383**	**331**	**361**	**327**	**302**	**334**	**331**	**329**	**-39**	**690**	**317**	**355**	**541**	**310**	**332**	**333**
TDM 17	**9964**	**9964**	**10016**	**9988**	**9950**	**10028**	**9983**	**9985**	**9027**	**9274**	**8433**	**6957**	**9024**	**9656**	**9448**	**9531**
TDM 16	**9578**	**9627**	**9650**	**9656**	**9643**	**9689**	**9647**	**9651**	**9052**	**8588**	**8110**	**6599**	**8483**	**9339**	**9111**	**9193**
Difference	**387**	**336**	**365**	**332**	**308**	**339**	**336**	**334**	**-25**	**686**	**323**	**358**	**541**	**317**	**337**	**338**

c) Hydro Project Modified Stream Flows

The base unregulated stream flows used in the Steps II and III system regulation studies are the same as the Step I studies (see Subsection 7(e) of AOP17), except for adjustments to add the effect of natural lake regulation and remove reservoir evaporation at projects not included in Steps II or III.

d) Hydro Project Rule Curves

The critical rule curves and refill curves were updated in accordance with procedures defined in POP, except for the changes described in Subsection 7(f) of the AOP17. The Mica/Arrow operating criteria for the Step I study is also used in the Step II study.

e) Other Hydro Project Operating Procedures, Constraints, and Plant Data

Changes to operating procedures, constraints, and plant data are described in Subsection 7(g) of the AOP17.

f) Steps II and III Critical Period and 30-year System Regulation Studies

The Entities conducted Step II (-12) and Step III (-13) critical period and 30-year system regulation studies for the 2016-17 operating year in accordance with procedures described in Section 3.3 of the POP. The system regulation studies use version 28 of the HYDSIM model. The critical period studies establish the length of the critical stream flow period, the hydro firm load carrying capability, and critical rule curves.

The Step II and Step III critical stream flow periods are unchanged from the DDPB16 studies. The Step II critical period comprises the 20 calendar-months from 1 September 1943 through 30 April 1945, and the Step III critical period consists of the 5.5 calendar-months from 1 November 1936 through 15 April 1937. The Step II critical period generation, as compared to DDPB16, decreases by only 3.1 aMW, but the average annual firm energy decreases by 17.4 MW. The Step III critical period generation decreases by 7.2 aMW, due to a reshaping of the hydro load during the critical period, including a large increase in March's hydro load and an even larger decrease in the hydro load during the first half of April. The average annual firm energy decreases by 69.4 aMW, again caused by the reshaping of the Step III hydro loads.

For the DDPB17, both the Step II and the Step III 30-year average generation totals remains the same as compared to DDPB16.

g) Downstream Power Benefits

The Canadian Capacity Entitlement increases from 1332.3 MW in the DDPB16 to 1333.2 MW in the DDPB17, an increase of 0.9 MW.

The Canadian Energy Entitlement decreases from 488.7 annual aMW in the DDPB16 to 484.0 annual aMW in the DDPB17, a decrease of 4.7 annual aMW. This decrease is caused mainly by the increase in thermal resources due to the increased firm load.

End Notes:

[1] The Treaty defines the Canadian Treaty Storage in English units. The metric conversion is a rounded approximation.

[2] The Step II DDPB17-12 30 year system regulation study dated 14 June 2011 and the Step III DDPB17-13 30-year system regulation study dated 25 April 2011 were used to determine the critical period and 30-year system generation.

TABLE 1A
DETERMINATION OF STEP I FIRM ENERGY HYDRO LOADS
FOR 2016-17 ASSURED OPERATING PLAN
(Average MW)

	Aug15	Aug31	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr15	Apr30	May	Jun	Jul	Ann. Avg.	CP Avg. 1/
1. Pacific Northwest Area (PNWA) Firm Load																
a) White Book Regional Firm Load 2/	22878	22878	21463	21462	23894	26022	26131	24981	23053	21904	21904	21421	22429	23816	23283	23379
b) Exclude 99% of UPL's Idaho load 3/	-491	-491	-456	-456	-455	-489	-458	-473	-442	-417	-417	-467	-541	-599	-479	-477
c) Update Coulee pumping 4/	29	-14	-6	0	0	-5	-1	-1	-2	-22	28	-4	-6	-16	-3	-3
d) …Total PNWA Firm Loads	**22416**	**22373**	**21000**	**21006**	**23439**	**25529**	**25671**	**24507**	**22609**	**21465**	**21515**	**20950**	**21882**	**23201**	**22802**	**22899**
e) Annual Load Shape in Percent	98.3	98.1	92.1	92.1	102.8	112.0	112.6	107.5	99.2	94.1	94.4	91.9	96.0	101.7	100.0	100.4
2. Flows-Out of firm power from PNWA																
a) White Book Exports, incl firm sp 5/	1423	1293	1276	1047	1011	974	993	963	1122	1166	1124	1004	1288	1317	1125	1116
b) Remove WB Canadian Entitlement	-492	-492	-492	-492	-492	-492	-492	-492	-492	-492	-492	-492	-492	-492	-492	-492
c) Add est. Can. Entitle. Exported 6/	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470	470
d) Added export for WB surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e) Added SeEx for WB Surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
f) Added SeEx for AOP Hydro 7/	29	0	0	99	10	11	21	0	0	369	76	80	256	0	59	54
g) Imp. Thermal used out of region 8/	259	274	292	208	137	61	54	83	44	100	86	158	264	245	159	158
h) …Subtotal for Table 2	1689	1545	1547	1332	1136	1023	1047	1024	1144	1612	1264	1221	1785	1540	1322	1305
i) Remove Plant Sales	-534	-417	-429	-406	-388	-361	-378	-355	-474	-471	-441	-335	-520	-460	-420	-415
j) Remove Flow-through-transfer	-75	-75	-75	-45	-45	-45	-45	-45	-45	-75	-75	-75	-75	-75	-60	-59
k) …Total	**1080**	**1053**	**1044**	**881**	**703**	**617**	**624**	**624**	**624**	**1066**	**748**	**811**	**1190**	**1005**	**842**	**831**
3. Flows-In of firm power to PNWA, except from coordinated thermal installations																
a) White Book Imports 9/	-820	-805	-749	-808	-1072	-1246	-1158	-1122	-978	-883	-853	-764	-863	-939	-948	-957
b) Remove UP&L imports for 1(b)	502	502	467	467	466	500	469	484	452	427	427	478	554	613	490	488
c) Remove Eastern Thermal Instal 10/	222	208	191	275	344	424	428	400	388	345	315	182	195	224	299	304
d) Added SeEx for WB Surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e) Added Can.Import for WB deficits 11/	0	-470	-305	0	0	-470	-470	-470	-470	0	0	0	0	-395	-235	-245
f) Added Calif.Import for WB deficits12/	0	0	0	0	0	0	-92	0	0	0	0	0	0	0	-8	-9
g) Added Seas.Exch. for Aop hydro 7/	0	-27	-21	0	0	0	0	-232	-341	0	0	0	0	-114	-59	-56
h) Remove Flow-Through-Xfers	75	75	75	45	45	45	45	45	45	75	75	75	75	75	60	59
i) …Total	**-21**	**-518**	**-341**	**-22**	**-217**	**-747**	**-777**	**-896**	**-904**	**-37**	**-37**	**-29**	**-39**	**-535**	**-400**	**-416**
4. PNWA Non-Step I Hydro and Non-Thermal Resources																
a) Hydro Independents (1929 water)	-1011	-1003	-989	-1040	-1122	-1060	-1020	-851	-966	-1145	-1162	-1438	-1348	-1117	-1094	-970
b) Non-Step I Coordinated Hydro(1929)	-512	-460	-552	-940	-912	-957	-1273	-673	-714	-718	-684	-634	-1086	-659	-800	-812
c) WB Regional Hydro NUGs	-305	-303	-224	-146	-113	-106	-97	-102	-134	-262	-263	-385	-417	-401	-225	-213
d) WB Renewable NUGs	-54	-54	-54	-54	-54	-54	-54	-54	-54	-54	-54	-54	-54	-54	-54	-54
e) WB Renewables	-988	-847	-746	-732	-736	-660	-690	-594	-1082	-1045	-907	-953	-1094	-888	-840	-820
f) …Total (1929)	**-2870**	**-2667**	**-2565**	**-2912**	**-2936**	**-2836**	**-3133**	**-2273**	**-2949**	**-3224**	**-3071**	**-3465**	**-3999**	**-3119**	**-3013**	**-2868**
5. Step I System Load (1929) 13/	**20606**	**20241**	**19138**	**18954**	**20988**	**22562**	**22385**	**21962**	**19380**	**19271**	**19155**	**18268**	**19034**	**20551**	**20231**	**20446**
6. Coordinated Thermal Installations 14/																
a) Columbia Generation Station (WNP2)	1030	1030	1030	1030	1030	1030	1030	1030	1030	1030	1030	715	515	947	954	965
b) Generic Thermal Installations	9408	9407	9460	9432	9394	9473	9427	9429	8447	8700	7837	6648	8971	9177	8957	9030
c) ...Total	**10438**	**10437**	**10490**	**10462**	**10424**	**10503**	**10457**	**10459**	**9477**	**9730**	**8867**	**7362**	**9486**	**10124**	**9911**	**9995**
7. Step I Hydro Resources (1929) 15/	**10855**	**10483**	**9270**	**9111**	**11241**	**12787**	**12660**	**12203**	**10555**	**10176**	**10916**	**11532**	**10205**	**11153**	**10991**	**11124**
8. Step I Resource Adjustments																
a) Hydro Maintenance	-32	-27	-9	-9	-4	0	0	0	-5	-7	-8	-20	-16	-51	-13	-12
b) Transmission System Losses 16/	-654	-653	-614	-610	-672	-728	-732	-700	-647	-628	-620	-606	-643	-674	-659	-661
9. Total Step I System Resources(1929)	**20606**	**20241**	**19138**	**18954**	**20988**	**22562**	**22385**	**21962**	**19380**	**19271**	**19155**	**18268**	**19034**	**20551**	**20231**	**20446**
10. Coordinated Hydro Load (1929) 17/	**11367**	**10944**	**9822**	**10051**	**12152**	**13744**	**13933**	**12876**	**11269**	**10894**	**11600**	**12166**	**11291**	**11812**	**11791**	**11936**
a) Coord. Hydro Load Shape (1929) 18/	96.4%	92.8%	83.3%	85.2%	103.1%	116.6%	118.2%	109.2%	95.6%	92.4%	98.4%	103.2%	95.8%	100.2%	100.0%	

Notes:

1/ The Step I critical period is the 42.5 months beginning 16 August 1928 and ending 29 February 1932.

2/ BPA Final 2010 White Book (WB10) total regional firm load estimate, which includes estimated Coulee pumping and Idaho loads served by Utah P&L.

3/ Annex B requires exclusion of Idaho load (and corresponding import) from area served by Utah Power Light in 1964.

4/ Although a minor change, Coulee pumping loads were updated to the 2009 PNCA data submittal to be consistent with the pumping flows in the Base Flows.

5/ WB10 exports include Firm Seasonal Exchanges, Flow-Through Transfers, Plant Sales, and an estimate of the Canadian Entitlement.

6/ Assumes 470 MW Energy Entitlement exported to Canada.

7/ Seasonal Exchanges were added as needed to make the Step I coordinated hydro load the same as the AOP16.

8/ Added thermal export to balance difference between thermal import and equivalent thermal installation based on generic annual shape.

9/ White Book Imports include coordinated thermal installations, seasonal & capacity exchanges, flow-through-transfers, and Skagit Treaty power.

10/ Imports identified as coordinated thermal installations are excluded, to be replaced by a portion of the Generic Thermal Installations.

11/ Added Canadian import as a portion of the resources needed to balance WB deficits, based on 50% of estimated 470 aMW of Energy Entitlement .

12/ Added Calif. import as a portion of the resources needed to balance WB deficits, based on the prorata procedure.

13/ Line 1(d) + line 2(k) + line 3(i) + line 4(f), based on 1929 hydro independent capability.

14/ Thermal installations are CGS, plus a generic thermal installation that is sized to meet the Step 1 System load minus Step I Hydro.

15/ Step I Hydro (US hydro projects at and upstream of Bonneville Dam) critical period capability shaped to 1929 load, line 5 minus line 6(c), 8(a), & 8(b).

16/ Transmission losses are 2.71% of all resources including imports.

17/ The Coordinated Hydro Model Load is the Step I Hydro Resources plus Non-Step I Coordinated Hydro, lines 7 - 4(b).

18/ The Coordination Hydro Model Load Shape shows the net effect of loads and nonhydro resources on the coordinated system hydro resources.

TABLE 1B
DETERMINATION OF STEP I FIRM PEAK HYDRO LOADS
FOR 2016-17 ASSURED OPERATING PLAN
(MW)

	Aug15	Aug31	Sept	Oct	Nov	Dec	Jan	Feb	March	Apr15	Apr30	May	June	July
1. Pacific Northwest Area (PNWA) Firm Load														
a) White Book Regional Firm Load	30874	30874	28692	29819	33384	35931	35900	34438	31744	29647	29647	29189	30462	32144
b) Exclude 99% of UPL's Idaho load	-641	-641	-589	-588	-596	-623	-588	-603	-561	-532	-532	-620	-744	-787
c) Adj.for Federal Peak Diversity 1/	-487	-523	-555	-353	-311	-535	-312	-321	-386	-495	-511	-514	-513	-421
d) Updates to Coulee pumping forec.	-33	-52	-49	-22	-15	89	132	120	-72	9	-18	8	2	-17
e) ….Total PNWA Firm Loads	**29714**	**29659**	**27500**	**28856**	**32462**	**34862**	**35133**	**33634**	**30724**	**28628**	**28585**	**28063**	**29206**	**30919**
f) Monthly Load Factors in Percent	75.44	75.44	76.37	72.80	72.20	73.23	73.07	72.86	73.59	74.98	75.26	74.65	74.92	75.04
2. Flows-Out of firm power from PNWA														
a) White Book Exports	2355	2355	2355	1994	1958	1955	1955	1955	1958	1988	1995	1851	2355	2355
b) Remove WB Canadian Entitlement	-1350	-1350	-1350	-1350	-1350	-1350	-1350	-1350	-1350	-1350	-1350	-1350	-1350	-1350
c) Add estimated Can.Entitle. exported	1332	1332	1332	1332	1332	1332	1332	1332	1332	1332	1332	1332	1332	1332
d) Added export for WB surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e) Add Seasonal Exch. WB Export	0	0	0	0	0	0	0	0	0	0	0	0	0	0
f) Added SeEx for AOP Hydro	29	0	0	99	10	11	21	0	0	369	76	80	256	0
g) Thermal Inst. used outside region 2/	257	257	279	152	117	10	0	77	55	59	25	151	267	248
h) …Subtotal for Table 2	*2624*	*2595*	*2616*	*2227*	*2067*	*1958*	*1958*	*2014*	*1994*	*2397*	*2078*	*2065*	*2860*	*2585*
i) Remove Plant Sales	-554	-554	-554	-554	-546	-543	-543	-543	-546	-546	-554	-410	-554	-554
j) Remove Flow-through-transfer	-75	-75	-75	-45	-45	-45	-45	-45	-45	-75	-75	-75	-75	-75
k) …Total	**1995**	**1966**	**1988**	**1629**	**1476**	**1370**	**1370**	**1426**	**1404**	**1776**	**1450**	**1580**	**2231**	**1956**
3. Flows-In of firm power to PNWA, except from coordinated thermal installations														
a) White Book Imports	-1080	-1080	-1017	-1119	-1444	-1619	-1631	-1599	-1283	-1177	-1177	-1065	-1138	-1215
b) Remove UP&L imports for	547	547	502	502	509	532	502	515	479	455	455	529	636	672
c) Remove Eastern Thermal Instal	312	312	293	425	463	573	583	505	500	488	488	315	281	321
d) Added SeEx for WB Surplus	0	0	0	0	0	0	0	0	0	0	0	0	0	0
e) Added Can.Import for WB deficits	0	-1332	-1332	0	0	-1332	-1332	-1332	-1332	0	0	0	0	-1332
f) Added Calif.Import for WB deficits	0	0	0	0	0	0	-92	0	0	0	0	0	0	0
g) Added Seas.Exch. for Aop hydro	0	-27	-21	0	0	0	0	-232	-341	0	0	0	0	-114
h) Remove Flow-Through-Xfers	75	75	75	45	45	45	45	45	45	75	75	75	75	75
i) …Total	**-146**	**-1505**	**-1499**	**-147**	**-427**	**-1802**	**-1924**	**-2098**	**-1932**	**-159**	**-159**	**-147**	**-146**	**-1592**
4. PNWA Non-Step I Hydro and Non-thermal Resources														
a) Hydro Independents (1932)	-1569	-1554	-1582	-1342	-1584	-1497	-1568	-1395	-1789	-1775	-1818	-1968	-2005	-1749
b) Non-Step I Coord. Hydro (1932)	-1821	-1980	-2006	-2075	-2142	-2114	-2019	-1867	-1752	-1711	-1811	-2012	-2361	-2440
c) WB Regional Hydro NUGs	-371	-369	-297	-214	-156	-143	-135	-146	-183	-297	-306	-433	-454	-444
d) WB Renewable NUGs	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76	-76
e) WB Renewables	-29	-29	-29	-29	-29	-29	-29	-29	-29	-29	-29	-29	-29	-29
f) …. Total (1932)	**-3866**	**-4008**	**-3990**	**-3737**	**-3987**	**-3860**	**-3828**	**-3513**	**-3829**	**-3888**	**-4040**	**-4519**	**-4925**	**-4738**
5. Step I System Load 3/ (1932)	**27697**	**26111**	**23999**	**26601**	**29524**	**30570**	**30751**	**29448**	**26366**	**26357**	**25836**	**24977**	**26366**	**26545**
6. Coordinated Thermal Installations														
a) Columbia Generating Station (cgs)	1130	1130	1130	1130	1130	1130	1130	1130	1130	1130	1130	565	565	1130
b) Generic Thermal Installations	11127	11127	11185	11284	11351	11396	11404	11374	10843	10682	10020	9096	10718	11127
c) ...Total	**12257**	**12257**	**12315**	**12414**	**12481**	**12526**	**12534**	**12504**	**11973**	**11812**	**11150**	**9661**	**11283**	**12257**
7. Step I Hydro Resc. Needed (1932) 4/	**25812**	**23854**	**21485**	**23419**	**26117**	**26361**	**26006**	**25094**	**22615**	**22924**	**22807**	**23353**	**23495**	**24195**
8. Step I Resource Adjustments														
a) Hydro Maintenance 5/	-4595	-4032	-3787	-3208	-2935	-2037	-1561	-2286	-2626	-2751	-2483	-2360	-2202	-3720
b) ...Hydro maint. as % reg. hydro capa	*15.3%*	*13.3%*	*12.4%*	*10.5%*	*9.6%*	*6.7%*	*5.3%*	*8.2%*	*9.8%*	*10.0%*	*8.9%*	*8.1%*	*7.2%*	*12.0%*
c) Transmission System Losses 6/	-1204	-1278	-1288	-1255	-1286	-1351	-1343	-1272	-1212	-1173	-1175	-1183	-1294	-1326
d) Reserves (11% of resources) 7/	-4574	-4690	-4727	-4769	-4854	-4929	-4885	-4593	-4385	-4455	-4463	-4494	-4917	-4861
e) ....Peak reserves as % resources	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*	*11.0%*
f) ….Total Adjustments	-10372	-10000	-9801	-9233	-9074	-8317	-7789	-8150	-8223	-8379	-8121	-8037	-8413	-9906
9. Required Step I Resources	**27697**	**26111**	**23999**	**26601**	**29524**	**30570**	**30751**	**29448**	**26366**	**26357**	**25836**	**24977**	**26366**	**26545**
10. Coordinated Hydro load and Surplus/Deficit (1932)														
a) Coordinated Hydro Load (1932) 8/	27633	25834	23491	25494	28259	28475	28025	26962	24368	24635	24617	25365	25856	26634
b) Actual Coord. Hydro Gen (1932) 9/	30052	30403	30451	30416	30590	30463	29605	28019	26684	27550	27864	29035	30694	30914
c) ...Surplus/Deficit (1932)	2419	4569	6960	4922	2331	1988	1580	1057	2316	2915	3247	3670	4838	4280

Notes:

1/ Federal peak diversity is a reduction in peak load due to peak loads not all being coincidental.

2/ Export or import to balance difference between excluded thermal imports and generic thermal installation.

3/ Total Step I Firm Peak Load is the sum of lines 1e + 2k + 3i + 4f

4/ Step I hydro resources needed to meet the load = line 5 minus lines 6c and 8f. Actual resource capability is higher. Used 1932 because has lowest surplus.

5/ From WB, based on 5-year PNCA average as a MW reduction from installed capacity.

6/ Transmission losses are 3.24% of all resources including imports, net of reserves and maintenance.

7/ Assumed value

8/ Lines 4b and 7

9/ System Instantaneous Peak (1932)

TABLE 2
DETERMINATION OF THERMAL DISPLACEMENT MARKET FOR 2016-17 AOP/DDPB STEPS II AND III STUDIES (Average MW)

	Aug15	Aug31	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr15	Apr30	May	Jun	Jul	Annual Average	CP Avg (42.5 mon)
1. STEP I THERMAL INSTALLATIONS																
a) From Table 1A, line 6(c)	10438	10437	10490	10462	10424	10503	10457	10459	9477	9730	8867	7362	9486	10124	9910.5	9995.3
2. DISPLACEABLE THERMAL RESOURCES																
a) Minimum Gen. from % of Thermal	234	234	236	235	234	236	235	235	210	217	195	166	223	229	223.0	224.8
b) Net Displaceable Thermal Resources	**10204**	**10203**	**10255**	**10227**	**10190**	**10267**	**10222**	**10225**	**9267**	**9513**	**8672**	**7196**	**9263**	**9895**	**9687.5**	**9770.4**
3. SYSTEM SALES (i.e. Amount of Coordinated Thermal Installation Power Used Outside PNWA)																
a) Flows-Out (Table 1A, line 2(h))	1689	1545	1547	1332	1136	1023	1047	1024	1144	1612	1264	1221	1785	1540	1321.8	1305.3
b) ...Exclude Can.Entitlement Exported	-470	-470	-470	-470	-470	-470	-470	-470	-470	-470	-470	-470	-470	-470	-470.0	-470.0
c) ...Exclude Plant Sales	-534	-417	-429	-406	-388	-361	-378	-355	-474	-471	-441	-335	-520	-460	-419.9	-415.1
d) ...Exclude WB Flow-Through-Transfer	-75	-75	-75	-45	-45	-45	-45	-45	-45	-75	-75	-75	-75	-75	-60.0	-58.8
e) ...Exclude WB. Seasonal Exchange	-205	-205	-197	-15	0	0	0	0	0	0	0	0	-79	-189	-57.4	-56.1
f) ...Exclude SeEx for WB Surp/Def	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
g) ...Exclude SeEx for AOP Hydro Diff.	-29	0	0	-99	-10	-11	-21	0	0	-369	-76	-80	-256	0	-59.3	-53.6
h) ...Exclude Other Flow-ThruTransfer	-8	-8	-7	-8	-8	-9	-100	-9	-8	-7	-7	-8	-8	-9	-15.9	-16.9
i) ...Exclude Other Seasonal Exchange	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
j) ...Total System Sales	368	370	369	290	215	127	33	145	146	220	194	253	377	337	239.3	234.8
k) Uniform Average Ann.System Sales	239	239	239	239	239	239	239	239	239	239	239	239	239	239	239.3	239.3
4 THERMAL DISPLACEMENT MARKET																
a) Line 2b minus line 3k	**9964**	**9964**	**10016**	**9988**	**9950**	**10028**	**9983**	**9985**	**9027**	**9274**	**8433**	**6957**	**9024**	**9656**	**9448.2**	**9531.1**

Notes:

2a Minimum generation is 0.0249 times the monthly average Step 1 thermal, without CGS; based on 2006 AOP data.

3b Canadian Entitlement exports are assumed to be supported by hydro instead of thermal.

3c Plant sales include Longview Fibre and approximately 25 percent of Boardman; line 2(i), Table 1A.

3d Flow-through-transfers from the White Book; line 2(j), Table 1A.

3e Seasonal Exchanges from the White Book

3f Seasonal exchange added to White Book value to export WB surplus; line 2(e), Table 1A.

3g Seasonal Exchanges were added as needed in this AOP to make the Step I coordinated hydro load the same as the AOP16.

3h Other flow through transfers are remaining flows-out supported by remaining thermal imports in the same period.

3i Other Season Exchanges remaining exports supported by thermal imports greater than imports on an annual basis

3j Total System Sales are total exports excluding exchanges, plant sales, flow-thru-xfers, and the Canadian Entitlement. The sum of Lines 3(a) through 3(i).

3k Average Annual System Sales shaped uniformly per 1988 Entity Agreement assumption that shaping is supported by hydro system.

4 PNW Area Thermal Displacement Market is the Total Displaceable Thermal Resources used to meet PNW Area firm loads. Lines 2(b) minus 3(k).

TABLE 3
DETERMINATION OF LOADS FOR STEP II AND STEP III STUDIES
FOR 2016-17 AOP/DDPB STUDIES

	PACIFIC NORTHWEST AREA LOADS				THERMAL INSTALLATIONS			
Period	Area Energy Load 1/ aMW	Annual Energy Load Shape Percent	Peak Load MW	Load Factor Percent	Energy Capability 2/ aMW	Annual Energy Shape Percent	Peak Capability MW	Capacity Factor Percent
August 1-15	22416	98.31	29714	75.44	10438	105.3%	12257	85.2%
August 16-31	22373	98.12	29659	75.44	10437	105.3%	12257	85.2%
September	21000	92.10	27500	76.37	10490	105.9%	12315	85.2%
October	21006	92.13	28856	72.80	10462	105.6%	12414	84.3%
November	23439	102.79	32462	72.20	10424	105.2%	12481	83.5%
December	25529	111.96	34862	73.23	10503	106.0%	12526	83.9%
January	25671	112.59	35133	73.07	10457	105.5%	12534	83.4%
February	24507	107.48	33634	72.86	10459	105.5%	12504	83.6%
March	22609	99.15	30724	73.59	9477	95.6%	11973	79.2%
April 1-15	21465	94.14	28628	74.98	9730	98.2%	11812	82.4%
April 16-30	21515	94.36	28585	75.26	8867	89.5%	11150	79.5%
May	20950	91.88	28063	74.65	7362	74.3%	9661	76.2%
June	21882	95.97	29206	74.92	9486	95.7%	11283	84.1%
July	23201	101.75	30919	75.04	10124	102.2%	12257	82.6%
Annual Avg. 7/	22801.8	100.00		74.11	9910.5	100.0%		82.7%
SI CP Avg(42.5mon)	22898.9			**74.03**	9995.3			
S2 CP Avg(20mon)	22944.9				10024.6			
S3 CP Avg(5.5mon)	24092.7	AvgAnnEn/JanPk=		64.9%	10211.3	AvgAnnEn/JanPk=		79.1%

	STEP II SYSTEM				STEP III SYSTEM			
Period	Total Energy Load 3/ aMW	Total Peak Load MW	Hydro Energy Load 4/ aMW	Hydro Peak Load MW	Total Energy Load 3/ aMW	Total Peak Load MW	Hydro Energy Load 4/ aMW	Hydro Peak Load MW
August 1-15	18535.8	24570	8097.9	12313	15989.9	21196	5552.0	8938
August 16-31	18500.4	24524	8063.2	12267	15959.4	21156	5522.2	8899
September	17365.1	22740	6874.7	10424	14980.1	19616	4489.6	7301
October	17369.9	23861	6907.9	11446	14984.2	20583	4522.2	8169
November	19381.2	26843	8957.6	14362	16719.2	23156	6295.6	10675
December	21109.4	28827	10606.0	16301	18210.0	24868	7706.7	12342
January	21227.5	29051	10770.4	16518	18312.0	25061	7854.8	12527
February	20264.6	27811	9805.1	15307	17481.3	23992	7021.9	11488
March	18694.9	25405	9217.8	13432	16127.2	21916	6650.1	9943
April 1-15	17749.2	23672	8019.6	11860	15311.4	20421	5581.7	8609
April 16-30	17790.3	23637	8923.1	12487	15346.9	20391	6479.6	9241
May	17323.3	23205	9961.3	13544	14944.0	20018	7582.0	10357
June	18094.1	24150	8607.7	12867	15608.9	20833	6122.5	9550
July	19184.4	25567	9060.6	13310	16549.5	22055	6425.7	9798
Annual Avg. 7/	18854.7		8944.1		16265.0		6354.5	
S2 CP Avg(20mon)	18973.0		8948.4					
S3 CP Avg(5.5mon)					17185.8		6974.5	
Joint Optimum S2 CP capability 5/ =			**8948.40**		S3 CP capability 6/ =		**6974.50**	
Energy load reduction=			**0**		Energy load reduction =		**0**	

Notes:

1/ The PNW Area load does not include the exports, but does include pumping.

2/ The thermal installations include all thermal used to meet the Step I system load. (Table 2, line 1a).

3/ The total firm load for the Step II/III studies is computed to have the same shape as the load of the PNW Area.

4/ The hydro load is equal to the total load minus the Step I study thermal installations for each period. Final Steps II/III hydro regulation studies used preliminary load calculations which vary from loads shown above by only 0.0 to 0.2 MW.

5/ Input is the assumed critical period average generation for the Step II hydro studies and is used to calculate the hydro energy loads.

6/ Input is the assumed critical period average generation for the Step III hydro studies and is used to calculate the hydro energy loads.

7/ The Annual Average is for the operating year. The Critical Period (CP) averages are for the historic water years.

TABLE 4
SUMMARY OF STEPS I, II, & III POWER REGULATIONS
FOR 2016-17 ASSURED OPERATING PLAN

	BASIC DATA		STEP I				STEP II					STEP III				
	NUMBER OF UNITS	MAXIMUM INSTALLED PEAKING CAPACITY MW	USABLE STORAGE kaf	USABLE STORAGE hm^3	CRITICAL CAPACITY FPLCC Feb.1932 MW	CRITICAL ENERGY FELCC Avg.Gen MW	USABLE STORAGE kaf	USABLE STORAGE hm^3	CRITICAL CAPACITY FPLCC Jan.1938 MW	CRITICAL PERIOD FELCC Avg.Gen MW	30 YEAR AVERAGE ANNUAL GEN. MW	USABLE STORAGE kaf	USABLE STORAGE hm^3	CRITICAL CAPACITY FPLCC Feb.1931 MW	CRITICAL PERIOD FELCC Avg.Gen MW	30 YEAR AVERAGE ANNUAL GEN. MW
1. HYDRO RESOURCES																
a) CANADIAN STORAGE																
Mica			7000	8634			7000	8634								
Arrow			7100	8758			7100	8758								
Duncan			1400	1727			1400	1727								
Subtotal			15500	19119			15500	19119								
b) BASE SYSTEM																
Hungry Horse	4	428	3072	3789	133	99	3008	3710	58	115	105	3008	3710	216	244	103
Kerr	3	160	1219	1504	167	123	1219	1504	178	112	130	1219	1504	179	159	125
Thompson Falls	6	85	0	0	85	55	0	0	85	53	58	0	0	85	66	58
Noxon Rapids	5	554	231	285	415	147	0	0	528	128	195	0	0	528	173	195
Cabinet Gorge	4	239	0	0	238	98	0	0	238	86	119	0	0	238	113	119
Albeni Falls	3	50	1155	1425	15	22	1155	1425	22	22	21	1155	1425	19	15	19
Box Canyon	4	74	0	0	70	46	0	0	72	45	48	0	0	70	56	47
Grand Coulee	24+3SS	6684	5185	6396	4703	2060	5072	6256	6368	1854	2419	5072	6256	4515	1229	2312
Chief Joseph	27	2535	0	0	2535	1062	0	0	2535	965	1302	0	0	2535	701	1232
Wells	10	840	0	0	840	419	0	0	840	387	487	0	0	840	287	442
Chelan	2	54	677	835	49	38	676	834	52	38	44	676	834	51	46	43
Rocky Reach	11	1267	0	0	1267	571	0	0	1267	528	690	0	0	1267	384	642
Rock Island	18	513	0	0	547	262	0	0	547	245	313	0	0	547	182	289
Wanapum	10	986	0	0	825	500	0	0	825	463	584	0	0	825	329	520
Priest Rapids	10	912	0	0	770	487	0	0	770	454	555	0	0	770	330	492
Brownlee	5	675	975	1203	607	243	974	1201	675	301	318	974	1201	583	259	319
Oxbow	4	220	0	0	220	101	0	0	220	126	130	0	0	220	116	130
Ice Harbor	6	693	0	0	693	215	0	0	693	231	303	0	0	693	163	303
McNary	14	1127	0	0	1127	625	0	0	1127	601	768	0	0	1127	443	716
John Day	16	2484	535	660	2484	940	0	0	2484	916	1251	0	0	2484	683	1214
The Dalles	22+2F	2074	0	0	2074	748	0	0	2074	730	992	0	0	2074	563	970
Bonneville	18+2F	1088	0	0	1047	564	0	0	1047	549	681	0	0	1047	433	640
Kootenay Lake	0	0	673	830	0	0	673	830	0	0	0	673	830	0	0	0
Coeur d'Alene Lake	0	0	223	275	0	0	223	275	0	0	0	223	275	0	0	0
Total Base System 1/		23742	29445	36320	20911	9426	28500	35154	22702	8948	11514	13000	16035	20912	6974.6	10930
c) ADDITIONAL STEP I PROJECTS																
Libby	5	600	4980	6143	170	195										
Boundary	6	1055	0	0	855	366										
Spokane Rivr Plnts 2/	24	173	104	128	152	94										
Hells Canyon	3	450	0	0	450	199										
Dworshak	3	450	2015	2485	435	156			NOT APPLICABLE TO STEPS II & III							
Lower Granite	6	932	0	0	930	182										
Little Goose	6	932	0	0	928	187										
Lower Monumental	6	932	0	0	922	183										
Pelton, Rereg,& RB	7	423	274	338	397	136										
Total added Step I		5947	7373	9094	5240	1698										
d) Total Hydro		29689	52318	64533	26151	11124	44000	54273	22702	8948	11514	13000	16035	20912	6975	10930
2. THERMAL INSTALLATIONS 3/			CpEn/AnnPk=80%		12504	9995	CpEn/AnnPk=80%		12534	10025	9911	CpEn/AnnPk=82%		12504	10211	9911
3. RESOURCE ADJUSTMENTS																
a) Hydro maintenance 4/			-8.7% of hydro		-2286	-12	-5.3% of hydro		-1197	n.a.	n.a.	-8.2% of hydro		-1706	n.a.	n.a.
b) Peaking reserves 5/			-11.9% of resc.		-4593	n.a.	-11% of resc.		-3876	n.a.	n.a.	-11% of resc.		-3676	n.a.	n.a.
c) Transmission losses 6/					-1272	-661			n.a.	n.a.	n.a.			n.a.	n.a.	n.a.
4. TOTAL RESOURCES 7/			CpEn/AnnPk=67%		30505	20447	CpEn/AnnPk=63%		30163	18973	21424	CpEn/AnnPk=61%		28035	17186	20840
5. Steps I, II, & III System Loads																
a) PNW Area firm load			CpEn/AnnPk=68%		33634	22899										
b) Net of Exports + Imports					-672	416										
c) Non-Step I resources					-1867	-812										
d) Hydro Independents					-1395	-970										
e) Miscellaneous resources					-252	-1086										
f) ...Net Step I,II,III System Load 8			CpEn/AnnPk=69%		29448	20446	CpEn/AnnPk=65%		29051	18973	18855	CpEn/AnnPk=72%		23992	17186	16265
6. SURPLUS (4 - 5f)					1057	0			1112	0	2569			4043	0	4575
CRITICAL PERIOD	Starts		August 16, 1928				September 1, 1943					November 1, 1936				
	Ends		February 29, 1932				April 30, 1945					April 15, 1937				
	Length (Months)		42.5 Months				20 Months					5.5 Months				
	Study Identification		16-41				17-12					17-13				

Notes

1/ The above totals may not exactly equal the sum of the above values due to rounding. The total Base System Storage for Steps I & II includes Canadian storage.

2/ Spokane River Plants include: Little Falls, Long Lake, Nine Mile, Monroe, Upper Falls, and Post Falls.

3/ From Tables 1a, 1b and 3.

4/ Step I hydro maintenance from Tables 1a and 1b. Steps II/III peak hydro maintenance is the same percent as Step I coordinated Hydro; no energy maintenance loss was included because impact is negligible. Hydro maintenance energy losses are not included in Steps II & III.

5/ Steps I, II, and III peak reserves are 11% of resources.

6/ Step I transmission losses from Table 1a and 1b. Steps II & III transmission losses are not included, since it would change the energy load by the same amount.

7/ Total Resources is the sum of total lines 1b+1c+2+3. For Step I, this does not include non-Step I coordinated hydro or hydro-independents.

8/ Step I energy load from Table 1a, line 5, and February peak load from Table 1b, line 5. Steps II & III energy load from Table 3. Steps II & III peak loads are equal to the Step II January and the Step III February energy load divided by their respective PNWA January or February load factor.

TABLE 5
COMPUTATION OF CANADIAN ENTITLEMENT
FOR 2016-17 ASSURED OPERATING PLAN

A. Joint Optimum Power Generation in Canada and the U.S.
(from agreement in place of the 17-42 30-yr study)
B. Optimum Power Generation in the U.S. Only (From 17-12 and 17-13)

Determination of Dependable Capacity Credited to Canadian Storage (MW)		
	(A)	**(B)**
Step II - Critical Period Average Generation 1/	8948.4	8948.4
Step III - Critical Period Average Generation 2/	6974.5	6974.5
Gain Due to Canadian Storage	1973.9	1973.9
Average Critical Period Load Factor in percent 3/	74.03	74.03
Dependable Capacity Gain 4/	2666.3	2666.3
Dependable Capacity Limit (from Table 4) 5/	5059.4	5059.4
Canadian Share of Dependable Capacity 6/	**1333.2**	**1333.2**
Determination of Increase in Average Annual Usable Hydro Energy (aMW)		
Step II (with Canadian Storage) 1/	**(A)**	**(B)**
Firm Energy 7/	n.a.	8944.7
Thermal Displacement Energy 8/	n.a.	2422.6
Remaining Usable Energy 9/	n.a.	58.6
System Average Annual Usable Energy	n.a.	11425.8
Step III (without Canadian Storage) 2/		
Firm Energy 7/	n.a.	6354.9
Thermal Displacement Energy 8/	n.a.	3800.3
Remaining Usable Energy 9/	n.a.	309.8
System Average Annual Usable Energy	n.a.	10465.1
Average Annual Usable Energy Gain 10/	968.0	960.7
Canadian Share of Average Annual Energy Gain 5/	**484.0**	**480.3**

1/ Step II values were all obtained from AOP 17-12 study.
2/ Step III values were obtained from AOP 17-13 study .
3/ Critical period load factor from Table 3.
4/ Dependable Capacity Gain credited to Canadian storage equals gain in critical period average generation divided by the average critical period load factor.
5/ From Table 4. Does not set a precedent or necessarily imply agreement on calculation of this value.
6/ One-half Dependable Capacity or Usable Energy Gain, as limited by Cap. Credit Limit.
7/ From 30-year average firm load served, which includes 7 leap years (29 days in Feb.), slightly different than Table 3.
8/ Average secondary generation limited to potential Thermal Displacement Market.
9/ Forty percent (40%) of the remaining secondary energy.
10/ Difference between Step II and Step III Annual Average Usable Energy.

TABLE 6
COMPARISON OF RECENT DDPB STUDIES
(English and Metric units)

	2012-13	2013-14	2014-15	2015-16	2016-17
AVERAGE PNWA ENERGY LOAD					
Annual Load (MW)	22614.8	22802.6	23013.7	22478.2	22801.8
January Load Factor (%) 1/	113.5	113.6	112.8	112.5	112.6
Critical Period (CP) Avg. Load Factor (%)	74.9	74.6	74.8	73.9	74.0
Annual Firm Exports 2/	1363.0	1605.0	833.0	832.3	841.9
Annual Firm Imports 3/	958.0	1177.0	467.0	378.6	400.4
Annual Non-Step 1 Hydro & Misc Rsrc 4/	2665.0	2841.0	2919.0	3022.4	3012.8
Total Annual Step 1 Load 5/	20355.0	20390.0	20462.0	19909.5	20230.6
THERMAL INSTALLATIONS (MW) 6/					
January Peak Capability	12878.0	12838.8	13734.6	12146.7	12533.5
CP Energy	10085.9	10125.5	10215.7	9662.4	9995.3
CP Minimum Generation	228.7	228.1	230.3	216.6	224.8
Average Annual System Export Sales	207.0	227.0	180.5	252.6	239.3
Average Annual Displaceable Market	9548.1	9577.7	9708.5	9111.5	9448.2
Average Annual Energy 7/	9982.0	10031.0	10117.0	9578.8	9910.5
HYDRO RESOURCES (aMW)					
Average Annual Step 1 Hydro Resources 8/	11058.0	11057.0	11021.0	10994.7	10991.3
Average Annual Step 1 Coord Hydro Load 9/	11851.0	11850.0	11819.0	11793.9	11790.9
STEP I/II/III CP (MONTHS)	42.5/20/5.5	42.5/20/5.5	42.5/20/5.5	42.5/20/5.5	42.5/20/5.5
BASE STREAMFLOWS AT THE DALLES 10/					
Step I 30-yr Avg Streamflow, cfs and m3/s	175361 | 4966	175361 | 4966	175120 | 4959	175084 | 4958	175084 | 4958
Step I CP Average, cfs and m3/s	114734 | 3249	114734 | 3249	114518 | 3243	114487 | 3242	114487 | 3242
Step II CP Average, cfs and m3/s	101578 | 2876	101578 | 2876	101396 | 2871	101376 | 2871	101376 | 2871
Step III CP Average, cfs and m3/s	56027 | 1587	56027 | 1587	56034 | 1587	56088 | 1588	56088 | 1588
CAPACITY BENEFITS (MW)					
Step II CP Generation	8940.2	8934.7	8944.9	8951.5	8948.4
Step III CP Generation	6962.9	6942.3	6898.7	6981.7	6974.5
Step II Gain over Step III	1977.3	1992.4	2046.2	1969.9	1973.9
CANADIAN ENTITLEMENT	1320.8	1335.5	1368.6	1332.3	1333.2
Change due to Mica Reoperation	0.0	0.0	1.5	1.2	0.0
ENERGY BENEFITS (aMW)					
Step II Annual Firm	8902.5	8897.9	8961.8	8960.1	8944.7
Step II Thermal Displacement	2484.0	2469.5	2423.9	2383.9	2422.6
Step II Remaining Usable Secondary	55.9	55.9	49.1	68.1	58.6
Step II System Average Annual Usable	11422.5	11423.3	11434.8	11412.0	11425.8
Step III Annual Firm	6233.5	6169.1	6300.7	6422.8	6354.9
Step III Thermal Displacement	3874.9	3920.9	3879.6	3681.8	3800.3
Step III Remaining Usable Secondary	325.0	326.3	294.7	330.0	309.8
Step III System Average Annual Average	10433.4	10416.3	10475.1	10434.6	10465.1
CANADIAN ENTITLEMENT 11/	504.5	505.5	479.9	488.7	484.0
Change due to Mica Reoperation	1.6	2.0	9.9	3.7	3.7
STEP II PEAK CAPABILITY (MW)	31439	31326	30944	28367	30163
STEP II PEAK LOAD (MW)	29265	29400	29236	27306	29051
STEP III PEAK CAPABILITY (MW)	31289	31215	30063	27703	28035
STEP III PEAK LOAD (MW)	25129	25162	25158	23568	23992

FOOTNOTES FOR TABLE 6

1. 100 x (January) / (average annual PNWA) firm loads (Table 1A, row 1(d)).

2. Average annual total firm exports (Table 1A, row 2(k)).

3. Absolute value of average annual total firm imports (Table 1A, row 3(i)).

4. Absolute value of average annual PNWA Non-Step I Hydro and Non-Thermal Resources (Table 1A, row 4(f)).

5. Average annual total Step I load (Table 1A, row 5).

6. Beginning with the 2006-07 DDPB, thermal installations include Columbia Generating Station and a generic thermal installation sized as needed to meet the Step I load. January thermal peak capability is shown, but actual minimum peak surplus month is February.

7. Average annual Energy from the thermal installations (Table 1A, 6(c)).

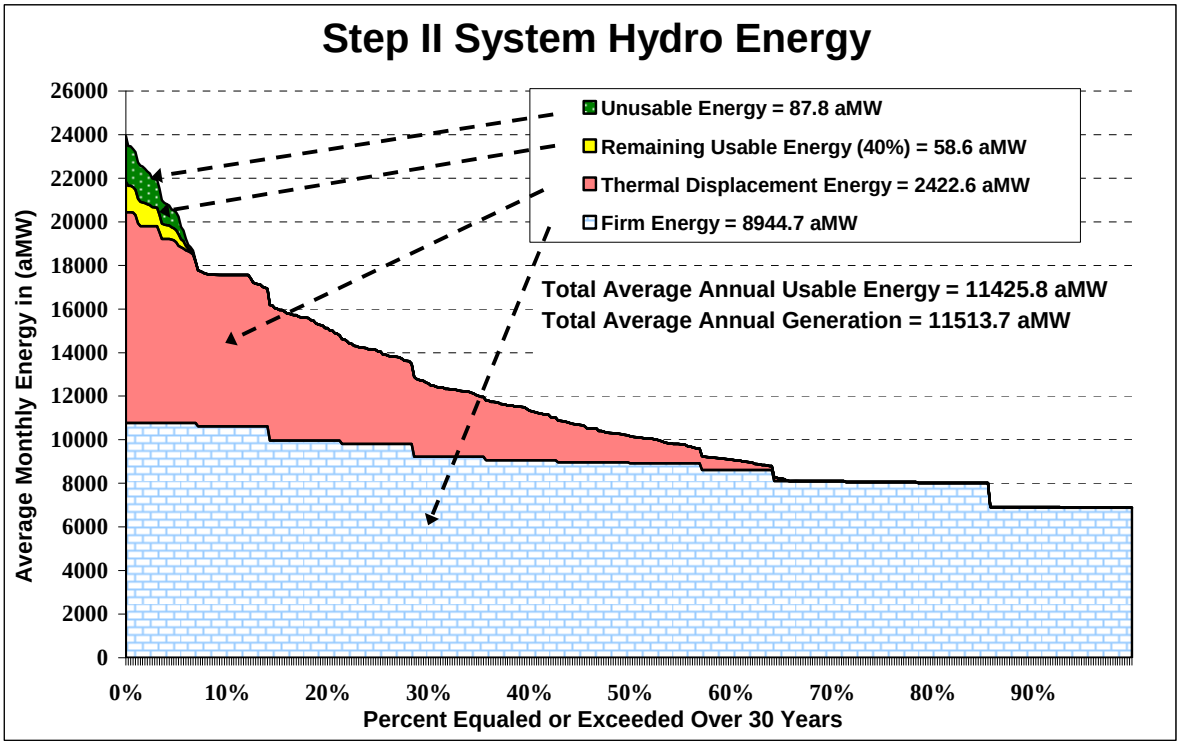
8. Average annual Step I Hydro Resources (Table 1A, row 7).

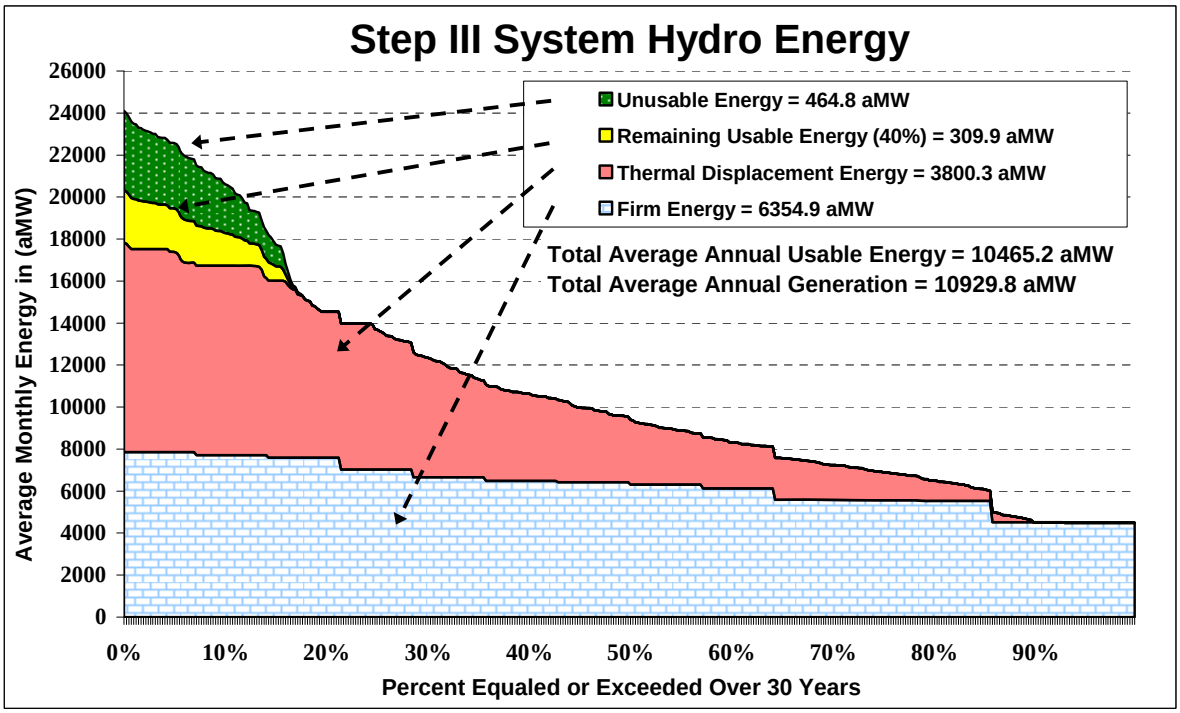
9. Average annual Step I Coordinated Hydro load (Table 1A, row 10). However, the AOP17 Step I study is defined to be the AOP16 Step I Joint Optimum hydro regulation study, and therefore the AOP16 hydro loads will be used in the DOP17 TSR.

10. The 2000 level modified flows were used beginning with the 2009-10 DDPB with adjustments for the Grand Coulee pumping and return flows. The 2012-13, 2013-14, 2014-15, 2015-16 and 2016-17 DDPBs include updated adjustments for the Grand Coulee pumping but not for return flows.

11. The energy benefits for 2012-13, 2014-15, and 2015-16 are all based upon Step II 30-year Joint Optimum hydro regulation studies. The energy benefits for 2013-14 and 2016-17 are based upon 30-Year U.S. Optimum hydro regulation studies, which includes an adjustment (+2.0 aMW for the 2013-14 study and +3.7 aMW for the 2016-17 study, respectively) to estimate the increase in the energy entitlement that would result from a joint optimum operation of the Step II study.

CHART 1
DURATION CURVES OF 30-YEAR MONTHLY HYDRO GENERATION
From the 17-12 and 17-13 Studies (Average monthly MW)





Values on chart above differ from the values on Table 5 by as much as 0.1 aMW due to rounding error.