Topics of Discussion Regarding the Slice Product
11/2/2007

This document provides additional information, as requested by the current Slice customers, regarding BPA's thoughts on how certain aspects of the future Slice product might work under proposals presented at the October 11 and October 24 Regional Dialogue workshops on Slice. The specific topics requested are as follows:

1. High flow situations
2. Elective spill conditions (spill due to lack of load)
3. Diversity of storage positions among customers and BPA
4. Storage pinch points
5. Fixed flow, or lower river control points

Additional data that will not be discussed at this workshop, but will be made available to interested parties upon request to BPA, is the hourly data underlying the 4-year analysis presented as part of the October 11 Regional Dialogue workshop on Slice. The data available includes estimates of what the Slice system hourly minimum and maximum delivery limits would have been for FY 2003 through FY 2006 if BPA had incorporated actual hourly generation values for the 4 lower Snake and 4 lower Columbia projects, rather than estimates of their individual capabilities (consistent with BPA's proposal for determining these limits under the post-2011 Slice contract). Also available are the actual Slice system hourly minimum and maximum delivery limits that were submitted to the Slice customers and an estimated net Slice system generation value (ANSSG) for each hour of the same 4 year period. This reflects the sum of the actual generation values for all Slice projects, less an estimated hourly System Obligation value.

Thoughts on the 5 requested topics:

<u>High flow situations</u> – High flow situations usually result in plentiful Slice energy and minimums delivery limits approaching maximum limits with restricted flexibility. Situations where flows rise or fall sharply are the ones that cause difficulty. Flows above the Snake projects, and within the lower Columbia can be especially flashy due to the lack of storage space and upriver regulation. Flows into Coulee can also rise sharply, but are typically tempered by upriver regulation.

With the current product implementation, impacts from sudden rises in streamflows are difficult to incorporate into Slice limits as they require significant manual processes on the part of the BPA staff. Often times, it seems BPA attempts to chase the rises, but has difficulty keeping up. BPA's intent would be to increase the minimum Slice delivery limits as needed to pass onto Slice customers the increased generation requirements resulting from the increased flows.

Under concepts for the future Slice product, when the Snake or lower Columbia rise sharply over a short time period, the expected generation reflected in BPA's internal modeling process (this may be a new or updated process relative to today's processes) would recognize the change in flows. Through hourly updates to Slice delivery limits based on these studies, the Rest of System delivery limits would naturally increase as well. As the flows and generation levels increase, the shape of the Snake and lower Columbia component would flatten as the expected operation approaches maximum capability. Once flows reach the point where one or more

projects must generate at maximum capability, any additional flow would result in spill and the Rest of System delivery limits would no longer increase for those projects.

Consider that the Snake projects can handle between 100 and 130 kcfs of flow with all turbines in service (not typically the case, they each have 6 units), depending upon the project. The lower Columbia projects can handle between 200 and 300 kcfs with all units in service (again, not typically the case, these projects have between 14 and 22 units each. At times when Snake flows rise into the triple digits, all 4 projects are likely to be running at or near full load around the clock. If during such a flow spike, the lower Columbia has between 200 and 300 kcfs flow, at least 6 of the 8 projects would be running at or near full load around the clock. In a case such as this, the ROS hourly min and max delivery limits would be very near maximum levels, with virtually no Flex available. Each customer's hydraulic link adjustment would also affect their ROS amount, either creating a little breathing room, or potentially pushing that customer into a forced spill situation.

In these conditions, to the extent storage flexibility exists at Coulee, customers would be able to reduce their Coulee/Chief deliveries to counteract the increased deliveries from the ROS projects. This would provide the additional benefit of reducing the customer's allotment of ROS energy on the following day, based on the hydraulic link concept. If a customer could anticipate such flow spikes on the Snake or lower Columbia ahead of time, they could reduce their GCL/CHJ schedules one-day prior to the event thereby reducing their ROS allotment during the event.

When flows into Grand Coulee are high the impact to Slice delivery limits would vary depending upon the type of system constraint Coulee's minimum or maximum discharge limit is based upon. If the Max constraint is based on Coulee's daily 1.5' draft limit, high inflows would result in a large Daily Max generation limit for Coulee/Chief. If the Max Coulee constraint is based on Chief Joe's turbine discharge capability or another downstream project discharge limit, then a high Coulee inflow could result in significant water being impounded into Coulee, rather than increasing the daily max limit. In this example, if Coulee storage space is not available (forced FCE draft, for example), high flows would result in full powerhouse generation plus spill at Chief and/or an inability to maintain the maximum flow requirement at the downstream project. Similar impacts to the GCL/CHJ daily minimum generation would result from high flows, depending upon the type of constraint controlling the minimum discharge requirement at Coulee and the storage space available.

Elective spill conditions – Elective spill typically occurs during high flow periods when regional generation is plentiful and supply of energy exceeds demand. In this condition generating entities often spill water past unloaded turbines.

In the current Slice contract special provisions have been developed to address this situation. Basically, if BPA declares that elective spill is imminent (while in Fixed Flow), Slice customers are allowed to schedule up to the hourly maximum delivery limits without depleting energy from their storage accounts. BPA needs to carefully consider whether such provisions should be included in the future Slice contract. The justification for such provisions was to maximize BPA's load in order to minimize spill and nitrogen gas levels during fish migration (since e-spill typically occurs during the fish season). An aspect of this provision that may not have been considered is that customers would receive more than their percent share of overall system energy, and may simply compete with BPA for the same finite market (displacing BPA sales) rather than actually increasing load and reducing spill.

During periods of E-spill when the system is not in a Fixed Flow state, BPA currently allocates E-spill after-the-fact on a daily basis, based on each customer's (and BPA's) energy volume scheduled during LLH. Customers who schedule the least amount of energy are allocated the most E-spill.

With the future Slice product, accounting for E-spill may become much simpler. The idea would be to incorporate into the ROS minimum hourly delivery limits, the total amount of e-spill expected to occur on the system. To the extent a customer schedules below that hourly minimum level, they would simply forfeit that energy. The ROS flex down accounts may need to be frozen during such conditions so a customer doesn't "store" the forfeited energy. To the extent BPA actually implements e-spill at Coulee or Chief, those amounts would need to be added into the GCL/CHJ actual generation (ANSSG) in order to keep storage accounting in check.

Diversity of storage positions among customers and BPA – BPA is hopeful that proposed changes, such as a GCL/CHJ Generation From Inflow (GFI) calculation with within-day updates, scheduling of GCL/CHJ energy separately, and accounting for a GCL/CHJ ANSSG will enhance the customers' ability to successfully manage their Slice storage within bounds. This, in turn, may reduce the need for grace margins and grace periods.

BPA's proposal is to determine Slice storage based on Coulee storage space only, which is the same as the current product. The difference will be that the storage energy determination would be based on the GCL/CHJ h/k, rather than the full system h/k, and the measure against which a customer's storage account would deviate from the system storage account would be based on the GCL/CHJ generation, rather than the full Slice system generation. This keeps all aspects of the storage accounting in similar terms.

Otherwise, BPA does not anticipate the storage aspect of Slice would work much differently in the post-2011 Slice world than it does in the current Slice world. Use of available storage space at Grand Coulee would be at the discretion of each customer, such that each customer could choose to manage their storage position within applicable limits that apply equally to BPA and the customers. However, as is the case with the current product, there will be times when the Federal operating agencies impose Federal Operating Decisions that will impact access to Coulee's usable storage (meaning storage bounds can suddenly and drastically change). BPA will maintain the right under the future Slice contract to impose limits on the use of Coulee storage in order to improve the probability of achieving operational requirements. The Corps and Bureau will continue to be responsible for managing the actual lake elevation for non-power uses and flood control. As is currently the case, the more divergent a particular customer's storage position becomes from the physical system, the greater the risk that the customer will be impacted by such FODs.

Storage accounting will be similar to today's method where BPA will determine an actual system storage position based on Coulee's actual elevation. For each customer, to the extent they schedule energy from the storage complex (GCL/CHJ) in an amount greater than or less than their share of the actual generation (likely measured on a daily basis), they will accumulate a storage deviation, which will determine how far they have "stored" or "drafted" from the actual system storage position. BPA would provide and estimated GCL/CHJ GFI value to represent the amount of energy a customer would need to schedule (from the storage complex) in order to maintain a constant storage position from one day to the next.

Accounting Example:

- Assume Grand Coulee can be operated between 1280 and 1290 feet (lower and upper storage bounds)
- Coulee's physical elevation is 1285 feet on a Monday at midnight

- Assume a 5% Slice customer has a storage deviation of zero at that time
- On Tuesday the storage complex actual generation is 50,000 MWh
    - The 5% Slice customer's share would be 2,500 MWh
- Assume this customer schedules 2740 MWh on Tuesday
- That customer scheduled 240 MWh greater than their "share" of the actual generation
- That customer "drafted" 240 MWh, or 10.0 MWd
- Their storage deviation is -10.0 MWd
- Their storage position is calculated as 5% of the physical storage system value in terms of MWd, minus 10.0 MWd
- Their lower and upper storage bounds are calculated as 5% of the 1280 and 1290 elevations converted to storage energy (GCL.CHJ h/k), in MWd
- The customers storage deviation would accumulate over time, such that they continue to draft or fill relative to the actual system position

Storage pinch points – Under today's operational constraints there are several times within each yearly operational cycle when Grand Coulee is required to achieve a specific elevation on a specific date (full at the end of the July 4th weekend, 1278 or 1280 at the end of August, and flood control around April 10th and possible April 30th).

These are managed in the current Slice product by having the upper and lower storage bounds converge at a particular point on a particular date, termed as "pinch points". BPA expects this will be handled in the same manner under the new contract. What may be different, though, is there will be an ability to estimate a customer's storage position on a within-day basis (based on then-current customer GCL/CHJ schedules and an estimated day-total GCL/CHJ generation) and provide feedback as to when a customer may be in jeopardy of violating the upper or lower storage bound. With this type of feedback capability, the customer should be expected to take action (change schedules) as needed to avoid violating the storage bounds. This would also reduce or eliminate the need for grace margins or grace periods which exist in the current product.

Fixed flow, or lower-river control points – As is the case today, there will be times during the future contract period when there is a specific flow requirement (or target) on the system that constitutes a condition known as "Fixed Flow". These situations typically occur during peak flow periods (May/June) when the Corps sets a specific flow at The Dalles dam, or during July/August when fish interests keep a close eye on week-average McNary flows and BPA develops weekly flow targets to maintain a smooth and steady reduction in flows over time (the TMT has been known to prescribe weekly flows at McNary during the fish season).

With the current product, Fixed Flow (whether based on a prescribed daily flow, or a weekly flow target) is defined as a state when the Daily Min and Max limits are set equal, and day-to-day flexibility is made available within the Pondage limits. In the future product, given the distinction between GCL/CHJ and Rest of System, today's approach to Fixed Flow will need additional thought and consideration. In the case of prescribed daily flows, initial thoughts lead to GCL/CHJ daily min/max limits being set equal, with modest GCL/CHJ Flex amounts potentially being available, and no flex available on the ROS (assuming flows are so high that the ROS hourly mins are equal to the hourly maxs). In the case of a week-average flow target, a concept similar to today's concept may be sufficient, where the GCL/CHJ daily min and max limits are set equal (based on the weekly target), and daily flexibility is offered through increased ROS and GCL/CHJ Flex amounts. Another

possibility would be to determine week-total energy volumes to be scheduled over a 7-day period, while providing some amount of daily flexibility through the Flex accounts.