A Framework for Slice Product Modeling and Scheduling Delivery Limits

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Under the future Slice contract, there is a desire to more accurately reflect within Slice delivery limits the detailed operating characteristics and constraints of the Federal System projects. Currently, the Slice delivery limits reflect a number of operating limits, including hourly, HLH, LLH, and daily minimum and maximum generation limits, storage limits, and ramping limits, among others. The schedule parameters are based on a combined generation schedule for the whole system with an incremental generation schedule for the Lower Snake projects. There are times when a specific project's flexibility limits do not easily flow into the current Slice delivery limits, especially as operating constraints and conditions change through time.

Some of the concerns raised regarding the Slice product could be addressed through more detailed modeling of the Federal System. In particular, models for the Coulee/Chief complex and the Lower Columbia complex (4 projects) could prove useful. For example, detailed modeling of the Lower Columbia complex should address some of the concerns related to uncertainty buffers.

Customer-specific schedules could then be created for each complex that meet delivery limits reflecting project limitations and constraints as represented in the input parameters and determined by the models. The Lower Columbia model could also adapt to each customer's GCL/CHJ operation by assigning an adjusted Priest Rapids discharge proportionate to their GCL/CHJ schedules. Output from the Lower Columbia model would include the hypothetical water routing associated with the customer's energy schedule and a determination that the schedule is within the delivery limits. Ongoing accounting would be maintained for each of the customers representing their cumulative deviation from the Lower Columbia actual operation. It is possible that the models could be implemented as a shared web-based model to which both BPA and the customer each have access (with different defined permissions for edit/changes and data manipulation). Alternatively, the models could also be completely housed at BPA with working copies provided to the customers for their internal use.

This outline contains additional details about how more detailed models would be used under the future Slice product concept:

Objectives

1. BPA and the Slice customers will work together to ensure Slice delivery limits are reasonably reflective of the system capability that remains after operating constraints and system obligations are met:
    a. The Slice customers' delivery limits will be based upon the same operational constraints (hard and soft limits) the BPA-PS marketer must adhere to.

b. BPA will provide guidance on operational objectives related to meeting the various non-power requirements of the system to the Slice customers who will strive to meet those objectives.
c. There will be transparency of the system constraints
    i. Daily communication of the constraints – daily summary sheet designed for consumption and comprehension by humans (not simply data files for populating the model). The summary will be revised if there are significant changes.
    ii. Hard and soft constraints need to be summarized appropriately.

Lower Columbia Project Model

1. There will be a detailed 4-project water routing model of the Lower Columbia Projects (McNary through Bonneville) to be used for the purpose of determining Slice delivery limits.
    a. It will run on an hourly time step for a 48-hour forward-looking time period and should run through an additional 5 to 7 days, although potentially in some other time increment besides hourly. It is expected that the model will be updated nearly every hour. Since the model is updated frequently, the differences between projected and actual conditions should be small and easy to address, although a mechanism for truing-up to actual will need to be included in the modeling.
    b. BPA will set the following model parameters. Prudent operating practices will factor into the inputs generated by BPA.
        i. Project operating limits (forebay/tailwater/discharge limits/etc), reflecting normal and special operations.
            a. Appropriate application of soft constraints needs to be addressed.
        ii. Inflows
        iii. Project efficiencies and turbine capacities
        iv. Fish spill requirements
        v. System wide requirements (e.g. Vernita Bar, Reserves, Regulating room above minimum generation). The system wide obligations may be handled in different manners depending on how the detailed modeling develops. As an example, the reserves may be applied as a reduction in usable capacity at the projects where BPA intends to carry the reserves for that hour. There are other methods for ensuring reserves are accounted for and the detailed discussions should include this topic.
    c. The model will produce the necessary information for the customer to determine whether they are within the delivery limits. Two options for communicating between BPA and the customers are [DECISION POINT]:
        i. BPA may run the model and publish delivery limits
        ii. BPA and the customer may share access to the model and the customer tests their schedules against the limits.

d. The customer's McNary inflow will be adjusted by their prior day's GCL/CHJ schedule
e. Spill past loaded and unloaded turbines will need to be addressed in the model.

Grand Coulee/Chief Joe Model

1. BPA will set operating parameters and other inputs to a detailed GCL/CHJ model similar to the LCOL model parameters stated above. The model will be a detailed water routing model of the two projects used for the purpose of determining Slice delivery limits. Two options for communicating between BPA and the customers are [DECISION POINT]:
    a. BPA may run the model and publish delivery limits representing the combined energy/capacity capability of the projects, or
    b. The customer may run the model to produce hourly schedules that could be met with the two-project capability.
2. Model should reflect all relevant operating limitations in effect at Grand Coulee/Chief Joe, including rolling 24-hr elevation limits & ramp rates.
    a. Mid-C operational constraints need to be reflected appropriately in the GCL/CHJ model (to the extent they impact BPA's operational flexibility).
    b. Inflow estimate to GCL will need to factor in incremental flows, upstream project releases, and the impact of Banks Lake pumping.
    c. PNCA impacts to be recognized – In Lieu, Provisional Draft, etc.
3. The GCL/CHJ model will need to have a 48-hour forward-looking hourly time step component similar to the LCOL model. It should also include a 5-7 day forward-looking component. Modeling beyond the 48-hour period may not require hourly time intervals.
4. Customer storage energy accounting will be required. One option, similar to the current process is to define a Customer Deviation Account that compares the customers' GCL/CHJ energy schedule to their percentage of the actual GCL/CHJ generation (similar to current SSDA) to determine the cumulative deviation from the physical system storage position.
5. The GCL/CHJ Model must link to LCOL model:
    a. Downstream linkage – the customer's GCL/CHJ schedule on Day 0 will be used to adjust the customer's MCN inflow on Day 1.
    b. Downstream flow requirements will limit the range of discharges allowed from GCL/CHJ.

Modeling Mechanics

1. Energy and Water Accounting
    a. Each subcomponent will have its own deviation accounting – GCL/CHJ, LCOL, LSN?, ROS, and system obligations.
    b. The LCOL, LSN?, and GCL/CHJ accounting mechanisms will run hourly. The system obligations and ROS will likely be a daily accounting.

   c. The benchmark for accounting will be actual system generation and elevations (current benchmark).
2. Application of Prudent Operation
   a. The project limits supplied by BPA as model inputs will reflect, from time to time, adjustments reflecting either objectively or subjectively determined prudent operations of the system.
   b. These adjustments will be included in the daily constraint summary.
   c. BPA will update and change prudent operating limits in real time as necessary
   d. There will be a process mechanism for BPA and the customers to review and discuss these limits to ensure a reasonable application of the limits over time. The goal is to foster a cooperative approach leading to a continuous improvement of the limits determination process.
3. Forecasting and Modeling Improvements
   a. Forecast and model errors are inevitable
   b. Customers and BPA acknowledge the consequences stemming from such errors can be either beneficial or detrimental.
   c. BPA will not attempt to track and account the cumulative consequences resulting from model errors, but the parties understand that the intent is that the beneficial and detrimental impacts will cancel out over time.
   d. BPA may consider the impact model errors may have had upon delivery limits on a case-by-case basis.
   e. BPA will review and assess model errors in an effort to improve model performance and accuracy, and shall revise model parameters appropriately.
   f. Additionally, BPA will occasionally run studies, given certain events or conditions, to measure model results against actual system output, and shall revise the models as needed to improve accuracy.

Rest of System

1. ROS will reflect the expected operation of non-dispatchable system for each hour.
2. The discretionary flexibility that is available in the ROS needs to be addressed (HGH, LIB, Canadian (Treaty and Special Storage), DWR).
   a. One method to address this would be to allow customers to request additional energy/capacity above the ROS delivery limits and BPA could determine if the energy/capacity is available.
   b. Another option would be to develop procedures and accounting needed to manage customer requests for discretionary storage use in a manner similar to measures BPA is required to follow.
      i. This may take the form of “discretionary generation” or “discretionary storage” rights
      ii. Projects with at-site generation, such as Libby, would provide “discretionary generation” where a customer could request a different generation than BPA’s request, but within the guidelines and parameters BPA must follow.

iii. Projects with no at-site generation, such as Arrow, would provide "discretionary storage" where a customer could request a different discharge than BPA's request, but within the guidelines and parameters BPA must follow.
iv. In either case shadow accounting would need to take place such that for each event the use of discretionary generation or storage is returned to a zero sum.

3. Treatment of Snake projects (LSN) needs to be addressed.
    a. Expected operation rolled into Rest of System (with or without flex),
        i. One method to address the flex would be to allow customers to request additional energy/capacity above the ROS delivery limits and BPA could determine if the energy/capacity is available at the Snake projects.
    b. Incorporated into the LCOL model process, or
    c. Separate modeling, scheduling, and accounting.

System Obligations

1. The sum of each hour's system obligations (such as those contained in the current Exhibit L) will be netted against the total energy deliveries to the customer for each hour.

Scheduling Mechanics

1. The customer will set hourly schedules compliant with the delivery limits.
2. The schedule will reflect customer's expected schedule rather than preschedule +/- purchases/sales already executed.
3. The delivery schedule will be a single energy schedule account for the Slice contract. The hourly energy schedule will be equal to the sum of the subcomponents, including GCL/CHJ, LCOL, LSN, ROS, and System Obligations. System Obligations are likely to be a reverse sign component of the sum on most hours.
4. Timeline for setting delivery limits shall be as described below. The timeline for submitting schedules will conform to the prevailing scheduling requirements of the Control Area Operator (Balancing Authority, etc.) The proposed timelines for setting delivery limits and schedules are as follows:
    a. Delivery limits for HE(X) will be set by beginning of HE(X-1) (e.g., delivery limits for HE 1300 will be set no later than 1100).
    b. Schedules typically submitted by the customer no later than 30 minutes after for the next clock hour (e.g., schedules for HE 1300 will be submitted by 1130).
    c. Changes required by Balancing Authority will be accommodated in a non-punitive manner.
    d. Re-dispatch events need to be addressed since they typically occur after the timeline for setting Slice delivery limits as described in 1(a) above.

        i. A distinction in treatment may need to be made between discretionary (Inc/Dec) and non-discretionary (required by the Balancing Authority) re-dispatch events.
    e. Large changes in delivery limits will be communicated to the customers ASAP.
    f. Schedules are firm for the hour.
    g. Preschedule information in the models may be different from the realtime information.
    h. If the Federal System is scheduled nodally on the grid, the determination of sources for the schedules will be separately determined from the modeling and scheduling process. This recognizes the right BPA has to optimize the overall operation of the federal system regardless of how customers may optimize their water routing strategy for their own contract.
5. The customers will be responsible for tagging and scheduling the power as appropriate.
6. A process for validating schedules against delivery limits will be developed, along with appropriate consequences for violations.