FISH PASSAGE CENTER

847 NE 19th Ave., Suite 250, Portland, OR 97232

Phone: (503) 833-3900 Fax: (503) 232-1259

http://www.fpc.org/

e-mail us at fpcstaff@fpc.org

MEMORANDUM

TO: RIOG Spill Operations Team

FROM: Michele DeHart

DATE: November 6, 2017

RE: Response to Spill Operations Team Questions from October 25, 2017 Meeting

On October 25, 2017, I attended a meeting with several members of the Spill Operations Team and representatives of the federal agencies. Those participating in the discussion were:

In person:
Jason Sweet, BPA
Ritchie Graves, NOAA
Dan Feil, USACE
Lisa Wright, USACE
Trevor Condor, NOAA
Judy Gordon, USFWS

On the phone: (may not be a complete list)
Paul Wagner, NOAA
Bill Hevlin, NOAA
Jay Hesse, NPT
Tom Lorz, CRITFC
Russ Kiefer, IDFG

The purpose of the meeting was to discuss the CSS Oversight Committee response to the Spill Operations Team (SOT) requests to utilize the CSS life cycle model to assess the effect of hourly operation changes at Little Goose Dam. During the discussion several questions and concerns were raised. The purpose of this memorandum is to respond to those questions and concerns. In summary:

- **The SOT request to utilize COMPASS and the CSS life cycle model to evaluate incremental benefits of hourly operations at an individual project is inconsistent with the resolution with which the CSS models have been calibrated. The strength of the CSS models, and the value of their perspectives, is that they are calibrated using larger samples across the entire FCRPS and the entire life cycle.**

- **The CSS evaluation of the 115%/120% spill versus the BIOP spill operations utilizes SYSTDG generated gas cap spill volumes over the spring migration at FCRPS projects. The CSS 115%/120% gas cap spill volumes and the recent HYDSIM assumed 115%/120% gas cap volumes are similar across the spring migration period and the entire FCRPS. Therefore the predicted fish benefits of the 115%/120% versus BIOP spill for fish operations presented in the 2017 and 2016 CSS Annual Reports are unlikely to differ a great deal by using the recent HYDSIM spill volume inputs.**

Incremental analyses using life cycle models

To reiterate, the October 17 response from the CSS Oversight Committee to the SOT, life cycle models such as the CSS Life Cycle model or COMPASS are not appropriate tools to assess effects at incremental scales, such as hourly operations at Little Goose Dam (FPC 2017b). This is because these incremental assessments are different than the temporal and spatial scales forming the foundation of the models. The powerhouse passage metric (PITPH) that is included in the CSS models is based on weekly (or longer) temporal cohorts, and the average spill proportions and flow conditions that the cohorts experienced. The cumulative PITPH metric also reflects the full, eight-project spatial scale (LGR-BON) of impacts on survival and SARs. Therefore, questions of hourly operations at one project (Little Goose Dam) are incongruent and use inappropriate temporal and spatial scales for applying the CSS models.

Comparing COMPASS and CSS Life Cycle models

The COMPASS and CSS Life Cycle models are completely different modelling approaches and have different model structures. Utilizing HYDSIM inputs to both models does not result in an “Apples to Apples” comparison between the two modelling approaches because the modelling approaches are very different, as has been discussed. Using the same HYDSIM inputs does not resolve the differences in model structure and approach that are present in the two models. Although the life cycle models have different structures and approaches it is still valuable to consider both model outputs to capture the range of potential results from management actions being considered. Considering both sets of modelling results further informs management decisions.

Aside from incremental analyses of Little Goose, the SOT is requesting CSS model runs comparing the Biological Opinion (Base Case) and the 115%/120% Injunction Spill Order. This specific model analyses has been completed and presented to the region in 2016 and 2017 CSS Annual Reports as well as the response report to the ISAB (May 12, 2017). These analyses and results are sufficient to provide an appropriate basis for understanding the biological improvements associated with the 115% /120% Injunction Spill Order.

The basis and results of CSS retrospective and prospective analyses have been documented in the May 12, 2017 submittal to the ISAB titled, “Documentation of Experimental Spill Management: Models, Hypotheses, Study Design and response to the ISAB” (CSSOC 2017). This document is a synthesis that provides the detailed descriptions for the prospective model comparisons of four spill scenarios: the BIOP, 115% /120%, 120% and 125% Total Dissolved Gas scenarios. Extensive and detailed analyses of the expected improvements in fish travel time, in-river survival, ocean survival, smolt-to-adult returns, and transport:in-river ratios

(TIR) associated with the 115%/120% spill management scenario are documented in this response report to the ISAB. The comparisons of each spill scenario are completed for three recent flow years that represent the present configuration of the system in low flow (2010), average flow (2009), and high flow (2011) years to provide a range of the expected outcomes of the spill management scenarios under different flow years. These analyses and results provide an appropriate basis for understanding the expected improvements in fish travel time, in-river survival, ocean survival, smolt-to-adult returns (SARs), and transport:in-river ratios (TIRs) under the 115%/120% spill management scenario. This document is an extensive synthesis of models and information that provides detailed documentation for the prospective model comparisons of these four spill scenarios and is also available for reference by the SOT.

In addition, CSS life-cycle analyses of the four spill scenarios are presented in the 2016 and Draft 2017 CSS Annual Reports (McCann et al. 2016; McCann et al. 2017), with an additional four-dam breach scenario. Across the non-breach scenarios, these analyses have shown that increasing spill for fish passage from the BIOP (Base Case) levels to 115% /120% levels could lead to an approximate 50% increase in fish return abundance. These same analyses have shown that an increase of spill for fish passage to the 125% total dissolved gas level could result in a 2-2.5 fold increase in adult abundance. The CSS models are calibrated to actual flow years and actual fish passage characteristics such as travel time that have occurred in those years. The comparisons of each spill scenario are done for low flow, average flow and high flow years in using the current project configurations.

The spill management scenarios that have been analyzed by the CSS are based on SYSTDG model runs conducted in 2012. The recent SYSTDG model outputs utilized in recent HYDSIM model runs to not appear to be dramatically different than spill volume caps used in CSS analysis the 115% /120% scenario.

In the May 12, 2017 response to the ISAB Chapter 4, page 54 describes the determination of spill volumes to meet the 115%/120% spill operation (CSSOC 2017). The USCOE utilizes the SYSTDG model to predict project spill volumes that will reach the total dissolved gas caps for the forebays and tailraces of each project, such as was done for the recent 115% /120% gas cap spill scenarios. The SYSTDG model is proprietary and not available to the fishery management agencies or the public. In order to conduct the CSS models comparisons of the four spill operations (BIOP, 115% /120% spill for fish passage operations, the 120% spill for fish operation and the 125% spill for fish passage operations) spill volumes at each project to reach those gas caps were determined. These spill volumes were determined by utilizing the USCOE SYSTDG model run projections for spill volumes to reach the 115%/120% gas caps in 2012. The USCOE utilizes SYSTDG model runs annually to estimate spill volumes at each project. These model run projections are useful to the USCOE to manage the distribution of spill in excess of generation and in excess of BIOP planned spill for fish passage such as occurred in 2012. Based upon the SYSTDG model predictions, BIOP spill for fish passage was provided and spill in excess of the BIOP requirements was implemented according to SYSTDG predictions of volumes at each project that would meet the 115% /120% gas caps. The spill volumes in the CSS comparisons of 115% /120% and BIOP scenarios were based on these 2012 SYSTDG model runs.

Along with the HYDSIM datasets, the SOT provided the key assumptions built into the HYDSIM modeling runs. We compared the 115% / 120% gas cap spill volumes generated by the

HYDSIM-SYSTDG modelling in the past weeks with the gas caps and the spill volumes from SYSTDG model runs in 2012 used in CSS modelling to compare the BIOP and 115% /120% gas cap operations (Table 1). There are some minor differences at individual projects but averaging across all projects and across the spring migration period there is no difference in spill gas cap volumes when comparing the CSS 115%/120% spill volumes with the HYDSIM 115%/120% spill volumes.

Across the entire spring migration and all projects the CSS gas cap volumes are the same as the HYDSIM 115/120% gas caps. This indicates that the benefits of the 115% /120% spill operations analyzed in the 2016 and Draft 2017 CSS Annual Reports are unlikely to change based on total dissolved gas caps used in the HYDSIM model runs.

Table 1. HYDSIM spill volumes to meet 115%/120% gas cap versus the 2012 SYSTDG model predictions to meet the 115% /120% gas cap in CSS analyses and comparison of the average seasonal spill across the spring migration at all projects in CSS and HYDSIM analyses

Project	1-Apr	CSS	2-Apr	CSS	May	CSS	June	CSS seasonal average	COE seasonal average
Lower Granite	39.9	41	40.4	41	32.9	41	34.4	41	37
Little Goose	38	40	38.5	40	36.6	40	40.6	40	38
Lo. Monumental	40.5	30	43	30	34.6	30	35.7	30	38
Ice Harbor	102	92	102	92	82.1	92	85.5	92	93
McNary	190	150	168.7	150	158.4	150	174	150	173
John Day	132	146	132	146	138.5	146	132.8	146	134
The Dalles	107	140	95	140	99	140	108.7	140	102
Bonneville	130	100	130	100	130	100	101.7	100	123
Total								739	739

Consistent with an adaptive management approach, it is important to note that model generated spill caps are useful for establishing a plan for implementing spill for fish passage. However, all models reflect inherent assumptions. We have seen recent SYSTDG model results that are inconsistent with actual monitoring data, such as the recent predicted spill caps of 200 Kcfs spill at Bonneville Dam to reach the tailrace gas caps. In our September 18, 2017 (FPC 2017a) response to questions from the SOT, we explained that the 200 Kcfs spill volume cap predicted by SYSTDG at Bonneville Dam was well outside the actual data observations over the past ten years. Furthermore, spill of 200 Kcfs has typically resulted in TDG of approximately124%, which would only occur under uncontrolled spill, due to flows in excess of hydraulic capacity or lack of power market. This highlights the importance of testing model outputs against empirical data collected during implementation of the operation. Actual spill for fish passage relative to a gas cap is implemented daily on the basis of dissolved gas monitoring. Fish passage models are useful in predicting results of implementing spill for fish passage operations based upon past data. However, a key component to adaptive management experiments which involve perturbations to a system is a robust monitoring program that is designed to detect the expected effect size. A monitoring program for total dissolved gas and a fish passage monitoring program are in place.

How is Ocean Survival calculated in the CSS?

Smolt-to-adult return rates are the product of in-river survival (Sr) and ocean survival (So). Mathematically, the equation is Sr * So = SAR. In-river survival is estimated using the Cormack-Jolly-Seber model and SARs are estimated using counts of adults divided by counts of smolts, and ocean survival is derived from these two estimates. Given estimates of in-river survival and SARs, estuary/ocean survival is calculated by dividing SAR by in-river survival, So = SAR / Sr, as described in Haeseker et al. (2012) and Chapter 4 of the CSS Annual Report (McCann et al. 2017). CSS analyses indicate that the largest increases in fish survival, resulting from increasing spill for fish passage, occurs during the estuary/ocean life cycle stages (CSSOC 2017).

Prior to the injunction spill order the USCOE and BPA have not managed spill for fish passage with the objective of the 115% / 120% gas cap at all FCRPS projects. The technical challenges to meeting the 115% /120% gas cap spill levels are ameliorated by the existence of a long-term dissolved gas and fish monitoring program and because the historic monitoring data indicates that adverse impacts to migrating juvenile fish do not occur until the total dissolved gas level exceeds 125%.

Managing to the 115% /120% gas cap spill for fish passage presents a new technical challenge for the COE, and the present SYSTDG model does not include data reflecting a directed objective of managing to the 115%/120% gas cap. However, the Gas Bubble Trauma monitoring program has been conducted over several decades and includes years in which the 115%/120% gas caps have occurred or have been exceeded. These monitoring data indicate that spill up to the 125% gas cap is not adverse to juvenile migrants. Therefore, there is a buffer for COE management up to the 125% gas cap, providing a buffer for precise management to the 115% /120% gas cap in the event that the 120% or 115% cap is exceeded. In addition, decades of monitoring data indicate that gas bubble trauma does not occur at the 115% forebay gas cap, providing an additional buffer for the management. Because spill has been shown to reduce fish delay in the forebays, further buffer is provided for potential exceedance of the 115% forebay gas cap.

The 115% /120% spill for fish passage is expected to reduce powerhouse passage rates (PITPH) and these reductions in PITPH are expected to improve fish survival and SARs.

Several components of past CSS Annual Report analyses address the effect of powerhouse passage on juvenile survival and SAR. In the 2010 and 2016 CSS Annual Reports (Tuomikoski et al,2010; McCann et al. 2016) analyses of bypass effects were conducted. In these analyses the passage histories of juvenile PIT tag fish that were known to have survived to Bonneville Dam were analyzed relative to the SAR of each passage history upstream of Bonneville. Those analyses indicated that the SAR of juvenile migrants was reduced by a relative 9-13% with each upstream powerhouse encounter. Detailed analyses of the magnitude of expected improvements in fish travel time, in-river survival, ocean survival, SARs, and Transport:In-river ratios(TIRs) are also provided in the CSS response report to the ISAB (CSSOC 2017).

The Draft 2017 CSS Annual Report (McCann et al. 2017) provides estimates of cumulative PITPH under the BIOP versus the 115% /120% operation that were used in CSS Life Cycle modelling. Based on these estimates the 115% / 120% operation reduces powerhouse encounters by 20% in high flow years, 29% in average flow years and 55% in low flow years.

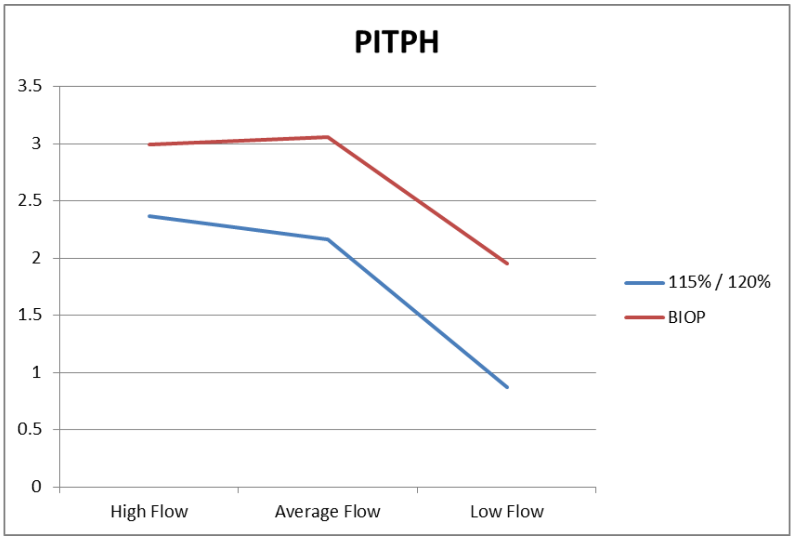

Figure 1. Estimates of PITPH under the BIOP and 115%/120% operations in high, medium, and low flow years. These estimated were originally reported in Table 2.2 of the Draft 2017 CSS Annual Report (McCann et al. 2017).

Literature Cited:

Comparative Survival Study Oversight Committee. 2017. Documentation of Experimental Spill Management: Models, Hypotheses, Study Design, and Response to ISAB. May 8, 2017. 138 p. http://www.fpc.org/documents/CSS/30-17.pdf

Fish Passage Center. 2017a. Additional follow-up questions regarding evaluation of the implementation of the injunction order for spill for fish passage at the 120%/115% dissolved gas cap. Memorandum sent on behalf of the CSS Oversight Committee. September 18, 2017. http://www.fpc.org/documents/memos/44-17.pdf

Fish Passage Center. 2017b. Request for CSS models analyses October 13, 2017. Memorandum sent on behalf of the CSS Oversight Committee. October 17, 2017. http://www.fpc.org/documents/memos/49-17ver2.pdf

Haeseker, S.L., J.M. McCann, J.E. Tuomikoski, and B. Chockley. 2012. Assessing freshwater and marine environmental enfluences on life-stage-specific survival rates of Snake River spring/summer Chinook salmon and steelhead. Transactions of the American Fisheries Society 141 (1): 121-138.

McCann, J., B. Chockley, E. Cooper, T. Garrison, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, T. Copeland, E. Tinus, E. Van Dyke, and R. Ehlke. 2016. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye, 2016 Annual Report. BPA Contract #19960200.

McCann, J., B. Chockley, E. Cooper, B. Hsu, H. Schaller, S. Haeseker, R. Lessard, C. Petrosky, E. Tinus, E. Van Dyke, A. Storch, and D. Rawding. 2017. Comparative Survival Study of PIT-tagged Spring/Summer/Fall Chinook, Summer Steelhead, and Sockeye, DRAFT 2017 Annual Report. BPA Contract #19960200.

Tuomikoski, J., J. McCann, T. Berggren, H. Schaller, P. Wilson, S. Haeseker, J. Fryer, C. Petrosky, E. Tinus, T. Dalton, and R. Ehlke. 2010. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook and Summer Steelhead, 2010 Annual Report. BPA Contract #19960200.