FISH PASSAGE CENTER

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MEMORANDUM

TO: Russ Kiefer, IDFG

FROM: Michele DeHart, FPC

DATE: December 6, 2017

RE: Impacts of Bonneville operations on juvenile passage at Bonneville

At your request, we have reviewed the available data regarding the proposed alternative being discussed in the Columbia River System Operation (CRSO) NEPA Environmental Impact Statement (EIS) process, of no-spill operation at Bonneville Dam during the fish migration season. We have reviewed the scientific basis of this proposal in detail and provide the results of our review in the following discussion. Consistent with established FPC processes this review is made available to the CRSO Fish Technical Team and the region. In addition, the FPC requests that this memorandum is included in the formal record for the NEPA EIS process for the CRSO EIS.

This proposal appears to result from the 2010 acoustic-tag survival study at Bonneville Dam (Ploskey et al. 2011). In that study, the authors concluded that, spillway survival for yearling Chinook smolts was lower than other routes of passage. Further they concluded that, for steelhead and subyearling Chinook in 2010, spillway passage was not statistically different from other passage routes. At dam survival estimation conducted relative to BIOP performance testing in 2011 concluded that there were not significant differences in the survival between routes. Our conclusions are:

- Like other acoustic tag studies for at dam performance standard evaluation, Ploskey et al (2011) does not provide a sound technical basis for fish passage management decisions because it does not account for delayed mortality due to powerhouse passage and the lower smolt-to-adult return rates associated with powerhouse passages.
- The technical and analytical flaws of the Ploskey et al. (2011) report preclude the use of this report as a basis for fish passage management decisions.

The FPC provided extensive technical comments regarding the Ploskey et al (2011) analyses and conclusions. Those comments were provided to the region. Our overall conclusion at the time, and now, is that the Ploskey et al. (2011) analyses and conclusions are flawed to the extent that they do not provide a robust scientific basis for fish passage management decisions. The FPC and CSS have also reviewed studies and conducted analyses on the impacts of powerhouse passage in the FCRPS, and the data clearly show the benefits of spillway passage for juvenile migrants. The preponderance of evidence for delayed mortality associated with powerhouse passage shows that powerhouse passage reduces smolt-to-adult return rates (Tuomikoski et al. 2010, Buchanan et al. 2011, McMichael et al. 2010, Petrosky and Schaller 2010, Haeseker et al. 2012, and McCann et al. 2016). Ignoring the large body of scientific analyses and relying on a single report with significant technical flaws does not represent rational decision making.

The FPC has reviewed other acoustic tag studies in addition to Ploskey et al. (2011). Our concerns from Ploskey et al. (2011) and other acoustic tag studies are summarized below. In addition, we are providing a few of our more relevant reviews (attached) and a list of all the review comments that the FPC has made of the years (Appendix A). Overall, we find that acoustic tag studies of dam survival do not account for delayed mortality associated with powerhouse passages and, therefore, should not be used to inform fish passage management decisions.

- Results from acoustic tag studies in 2010 and 2011 do not support the proposal to eliminate spill at Bonneville Dam. In 2010, the spillway had the lowest survival of all passage routes for yearling Chinook. However, spillway passage for steelhead in 2010 has significantly higher survival than turbines in both powerhouses. In 2011, the spillway did not have lower survival than other routes of passage.
    - The study design in 2010 differed from other acoustic tagging studies in that no control fish were released. Instead, fish that passed through the Corner Collector were used a pseudo "control". This is an inappropriate statistical design and only single-release estimates should be used (FPC Memo March 23 2012, attached).
    - Flows through non-turbine routes were not accurately measured during the 2010 test, limiting the ability to interpret study results (FPC Memo September 11 2015, attached).
    - Sluiceway gates were not fully functional during the testing period, which affects overall passage distribution and the impacts of different routes of passage (FPC Memo September 11 2015, attached).
    - The Bonneville Corner Collector was not fully functional due to an outage at the adjacent turbine (FPC Memo September 11 2015, attached).

- Survivals under the proposed operation of no spill at Bonneville Dam during the smolt migration has not been tested, so the impacts on dam survival are unknown. Extrapolation from testing with spill operations of 100 Kcfs to zero spill is a gross misuse of test results.

- The proposed operation to reduce spill at Bonneville ignores the large body of evidence that spillway passage reduces delayed mortality associated with powerhouse passage and increases adult returns. By using acoustic tag studies, these survival tests are limited to

concrete survival and do not reflect the best science regarding the impacts of the hydrosystem on anadromous fish. Please see FPC memos from June 24 2009, July 28 2010, February 15 2012, March 9 2012, March 16 2012, March 23 2012, January 4 2013, December 3 2013, May 2 2014, October 17 2017,

  - Juveniles that pass through turbines have consistently lower survival rates (Muir et al. 2001) than other passage routes.
  - Juveniles that pass through collection and bypass systems experience substantial migration delay and have reduced survival at later life stages (Tuomikoski et al. 2010, Buchanan et al. 2011, McMichael et al. 2010, McCann et al. 2016). Powerhouse passage is associated with reduced ocean survival and lower smolt-to-adult return rates (Petrosky and Schaller 2010, Haeseker et al. 2012, McCann et al. 2016).

- The proposed operation of zero spill does not account for higher mortality observed with increasing flow through powerhouses. Increased turbine flow at Bonneville above the mid-range of 1% is associated with higher mortality through the JBS, largely due to increased turbulence in the gatewells. Eliminating spill at Bonneville will significantly increase turbine flow. The negative impacts of high turbine flow highlights the need to consider dam operations as a whole, rather than individual route-specific survival estimates. Please see FPC memos from March 9 2012, April 24 2012, June 7 2012, December 17, 2012, June 8 2015 and SORs 2012-1, 2012-2 and 2013-3.

- The acoustic tagging studies used to generate route-specific survivals have been extensively reviewed by the FPC. Numerous flaws inherent in the study design have been identified that significantly reduce the applicability of the studies to estimates of the impacts of the hydrosystem on Chinook and steelhead. Please see the references listed in Appendix A. The limitations of performance standards testing include:

  - Lack of representation of the run-at-large: Acoustic tagging requires high rejection rates of smolts due to size or condition. This results in survival estimates that are only representative of the largest, healthiest smolts, and thereby inflates estimates. Rejection rates for performance testing have ranged from 3% to 18%.
  - Testing in one or two years does not provide adequate data regarding the impacts of dam passage during all water years.
  - The virtual-release study design does not include forebay mortality or delay in survival estimates, and therefore inflates survival estimates and underestimates mortality due to dam passage.
  - All individuals used in acoustic tagging studies are collected in juvenile bypass systems, which do not represent the run-at-large and may bias the test towards high passage and survival through bypass systems.

Literature Cited

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Appendix A

FPC Memos and Joint Technical Staff Memos Regarding Performance Testing

June 24, 2009: Review of "Statistical Design for the Lower Columbia River Acoustic-Tag Investigations of Dam Passage Survival and Associated Metrics"

http://www.fpc.org/documents/memos/91-09.pdf

July 29, 2010: Review of Acoustic Telemetry Evaluation of Juvenile Salmonid Passage at John Day Dam, 2009 Draft Final Report

http://www.fpc.org/documents/memos/93-10.pdf

February 16, 2011: Review Performance Standard Testing/John Day 2010

http://www.fpc.org/documents/memos/20-11.pdf

March 24, 2011: Review 2011 Acoustic Tag study design for John Day Dam

http://www.fpc.org/documents/memos/37-11.pdf

June 21, 2011: John Day Acoustic Tagging Compliance Monitoring

http://www.fpc.org/documents/memos/91-11.pdf

February 15, 2012: Acoustic tagging studies in the Lower Columbia, performance standards, and review of "Analysis of Dam-Passage Survival of Yearling and Subyearling Chinook Salmon and Juvenile Steelhead at The Dalles Dam, Oregon, 2010"

http://www.fpc.org/documents/memos/11-12.pdf

March 16, 2012: FCRPS Juvenile Performance Standards and Metrics

http://www.fpc.org/documents/memos/25-12.pdf

March 23, 2012: Comments on BON and TDA Performance Standards Testing in 2010

http://www.fpc.org/documents/memos/31-12.pdf

January 4, 2013: Summary of Comments on Performance Testing

http://www.fpc.org/documents/memos/02-13.pdf

February 11, 2013: 2010 Performance Testing at Lower Monumental and Little Goose Dams

http://www.fpc.org/documents/memos/15-13.pdf

March 19, 2013: Performance Testing at Lower Monumental and Little Goose Dams, 2009 and 2012

http://www.fpc.org/documents/memos/32-13.pdf

March 22, 2013: 2012 Performance Tagging at Lower Columbia Dams

http://www.fpc.org/documents/memos/44-13.pdf

October 7, 2013: Review Comments, 2013 Draft FCRPS Supplemental Biological Opinion

http://www.fpc.org/documents/memos/120-13.pdf

December 3, 2013: Response to request – Review BPA SMART Spill PowerPoint Presentation

http://www.fpc.org/documents/memos/138-13.pdf

January 14, 2014: Performance testing at LGS and LMN Dams for subyearling Chinook in 2013

http://www.fpc.org/documents/memos/05-14.pdf

January 21, 2014: Comments on draft report "BiOp Performance Testing: Passage and Survival of Subyearling Chinook Salmon at Little Goose and Lower Monumental Dams, 2013"

http://www.fpc.org/documents/joint_technical/07-14.pdf

January 27, 2014: Review of BPA/COE/Skalski presentation to the Independent Scientific Advisory Board on 1/17/14

http://www.fpc.org/documents/memos/10-14.pdf

January 27, 2014: Comments on draft report "Compliance monitoring of yearling and subyearling Chinook salmon and juvenile steelhead survival and passage at McNary Dam, 2014"

http://www.fpc.org/documents/joint_technical/21-15.pdf

May 2, 2014: Performance testing at LGS and LMN Dams for subyearling Chinook

http://www.fpc.org/documents/memos/60-14.pdf

February 3, 2015: Comments on draft of Compliance monitoring of yearling and subyearling Chinook salmon and juvenile steelhead survival and passage at McNary Dam, 2014

http://www.fpc.org/documents/memos/25-15.pdf

February 20, 2015: Comments on draft of Compliance monitoring of subyearling Chinook salmon survival and passage at John Day Dam, 2014

http://www.fpc.org/documents/memos/33-15.pdf

February 20, 2015: Comments on draft report "Compliance monitoring of subyearling Chinook salmon survival and passage at John Day Dam, 2014"

http://www.fpc.org/documents/joint_technical/34-15.pdf

June 8, 2015: Comments on "Systematic review of JSATS passage and survival data

at Bonneville and The Dalles Dams during alternative turbine and spillbay operations from 2008 – 2012"

http://www.fpc.org/documents/memos/92-15_rev1.pdf

June 8, 2015: Comments on "Systematic review of JSATS passage and survival data at Bonneville and The Dalles Dams during alternative turbine and spillway operations from 2008 – 2012"

http://www.fpc.org/documents/joint_technical/96-15.pdf

Sept 11, 2015: SRWG evaluation of performance testing at Bonneville Dam

http://www.fpc.org/documents/memos/139-15.pdf

August 17, 2016: Review "Factors influencing the survival of outmigrating juvenile salmonids through multiple dam passage: an individual-based approach". Elder, Woodley, Weiland, Strecker, June 23, 2016"

http://www.fpc.org/documents/memos/47-16.pdf

Nov 9, 2016: Comments RE: "Examination of Ice Harbor Dam BiOp performance standard evaluation assumptions" by Harnish et al. (2016)"

http://www.fpc.org/documents/memos/58-16.pdf

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MEMORANDUM

TO: Ed Bowles, ODFW
Rick Kruger, ODFW
Tony Nigro, ODFW

FROM: Michele DeHart

DATE: March 23, 2011

RE: Comments on BON and TDA Performance Standards Testing in 2010

In response to your request the FPC staff has reviewed the PNNL reports prepared for the US Army Corps of Engineers titled "Survival and Passage of Juvenile Chinook Salmon and Steelhead Passing Through Bonneville Dam, 2010" and "Survival and Passage of Yearling and Subyearling Chinook Salmon and Steelhead at The Dalles Dam, 2010." These reports document acoustic tagging studies conducted to address if individual projects are meeting the performance standards required in the 2008 Federal Columbia River Power System Biological Opinion (BiOp). These performance criteria include dam passage survival of 96% for yearling Chinook and Steelhead, and 93% for subyearling Chinook. Both of these studies raise concerns about experimental design, methodology, statistical analysis, and the limitations of these types of studies. Our overall conclusion is that neither of the studies and results completed for Bonneville or The Dalles dams is adequately robust to support a hydroelectric project operations decision. Our summarized comments are listed below, followed by a detailed discussion of each article.

The 2010 study at Bonneville Dam was a single release design utilizing fish tagged upstream for studies at other projects. Because of this, the study differs significantly from the design approved for performance standards testing at other projects.

- All fish utilized in this study were tagged at one of three upstream sites. Utilizing these fish for downstream studies requires that survival of each tagging group is

equal in reaches they all pass through. This was not true for all groups in this study, indicating increased mortality over time associated with acoustic tags. This may result in a high-grading of tagged fish if only the largest or healthiest tagged fish survival tagging mortality to the Bonneville forebay.

- The report provides misleading survival estimates for discussion. The single-release design used at Bonneville lacks a control group. Consequently, the estimates include tailrace mortality and are theoretically lower than expected with a paired release design that addresses mortality that occurs away from the concrete. To compensate for this the report makes estimates of what survival would have been if the study had been a paired-release study, using survival estimates from the B2 corner collector as a "pseudo" control. This constructed estimate violates basic tenets of experimental design and generates a significant upward bias. However, it is misleadingly repeated within the report, rather than the results of the single-release study that was actually conducted.

- At The Dalles Dam, a virtual/paired-release study design was used. The use of a third release group, utilized as a second control, may artificially inflate dam survival estimates. This upward bias in survival estimates may be caused by differential mortality between groups due to random sampling effects or environmental factors such predation.

- The studies at both projects have similar issues due to the limitations of using acoustic tagging.

  - Acoustic tags require the rejection of a high percentage of fish due to size or condition. The rejection rate in 2010 was 16%, so survival estimates are not likely to represent the run-at-large.

  - The assumption that tagged fish should experience equal mortality over stretches of river they share, regardless of their tagging location, was violated in the 2010 study. This required the elimination of some groups for consideration in the BON study, and calls into questions the assumptions of limited tag-related mortality throughout the area covered by these studies.

  - The short tag life in acoustic tagging studies means that these studies can only provide survival estimates for short reaches. Long term effects of passage routes cannot be evaluated with this method.

- The limitations of acoustic tag studies indicate that they should not be used as the sole measure of hydrosystem survival. Decisions on project operations should incorporate all available data, including studies on the cumulative effects of multiple dam passage and delayed mortality associated with passage route.

Survival and Passage of Juvenile Chinook Salmon and Steelhead Passing Through Bonneville Dam, 2010

The 2010 acoustic tag study at BON was not intended as a compliance test for performance standards. The single-release study design is not the same as the compliance testing at other dams, the spill patterns were not finalized and varied over the course of the season, and total spill volumes were not controlled during the yearling Chinook and juvenile Steelhead migrations.

This methodology used in the study requires the assumption that there are no effects of tagging, such as differential mortality among tagging groups that would compromise the applicability of the results to the run-at-large. However, this assumption was violated for subyearling Chinook, where fish tagged at the most upriver site (Roosevelt, WA) had significantly higher mortality than groups tagged further downriver (The Dalles Dam tailrace, and Hood River, OR) in the sections of river that both groups migrate through (Beeman et al. 2011). This indicates that tagged fish may undergo selective pressures relative to the distance travelled while tagged. The fish that survive to BON from upriver tagging sites may be significantly more fit than the general population of tagged fish, inflating survival estimates that would not be representative of the run-at-large.

The single-release design used in this study lacks a control group. This design avoids upward bias due to random sampling effects or differential mortality between groups, as in the 2010 studies at TDA (see discussion below). However, PNNL presents an "estimated survival" as if the study had been a virtual/paired-release. This calculation uses estimated survival through the BON Corner Collector as a pseudo "control." This inflated survival estimate is not an appropriate modification to the single-release design and violates basic principles of experimental design. Despite this fact, these values are utilized throughout the document as survival estimates, including comparisons to historical values that were obtained through actual virtual/paired-release designs. The survival estimates are upwardly revised enough that yearling Chinook and Steelhead are modified from not meeting performance standards to exceeding them. This is extremely misleading as it does not reflect the actual results and limitations for this study.

Although the summer subyearling Chinook study design called for comparison of survival at two different spill operations (24-h, 95-Kcfs and 85-Kcfs day/120-Kcfs night) in 16 block treatments. However, spill could only be controlled from July 2 to July 18 so only 9 blocks were used. One of the blocks had very few fish and so was pooled with another block, leaving 8 testing blocks in total. No statistically significant difference between operations was detected, although test power was low. On July 15, the 85-Kcfs day/120-Kcfs night black had only 48 fish, the smallest sample size in the study. The survival of this group was much lower than other testing blocks and has a much larger confidence interval. This single group may have had a disproportionate effect on the treatment mean and affected the final analysis. No power analysis was done to determine the required sample sizes and number of blocks to detect a difference between the two spill operations.

Although a difference in survival under different spill operations was not observed in this study, the power was low and many sample sizes were low. If there is an undetected difference in survival under spill operations, pooling the results from all testing blocks to generate a single survival estimate, as done for 2010 performance standards, will be statistically inappropriate.

Survival and Passage of Yearling and Subyearling Chinook Salmon and Steelhead at The Dalles Dam, 2010

In contrast to the 2010 study at Bonneville, the study at The Dalles Dam used a virtual/paired-release design with two control groups, one released in the tailrace of the dam (R_2) and one released further downstream (R_3). The R_3 group is intended to account for any handling mortality experienced by the R_2 group. The survival estimates of these two groups are used together (S_2/S_3) as a control for the experimental group passing the dam. The intent of the R_3 group is to avoid upwardly biasing dam survival estimates due to handling mortality expressed in the tailrace of the dam.

However, survival estimates generated with this multiple-release design actually further increased dam survival estimates due to random sampling effects, in some cases moving survival estimates upward enough to meet performance standards when they would not have with only one control group. If there is limited handling and transportation mortality, the use of the R_3 group will introduce additional variation to the study. Beeman et al. (2011) concluded that this result is "contrary to the goal of adjusting a paired-release estimate downward to account for handling mortality."

Upward biasing of survival estimates could also be caused by higher mortality in the R_2 group. It is unlikely that tagged fish in both stretches of river encounter the same environmental conditions, especially since predation rates are higher in the forebay and tailrace than mid-reservoir at many projects (Petersen 1994, Ward et al. 1995). If survival in the R_2 group is lower than survival in the R_3 group, the ratio of survivals (S_2/S_3) will be biased low and will artificially increase estimates of dam survival. Please see Beeman et al. (2011) and the March 24, 2011 FPC Memo for detailed descriptions upward biases inherent in this study design.

A further cause of differential mortality may be the fact that fish that are released at a specific location will not have the vertical or horizontal distribution of fish that have been released upriver. At The Dalles Dam, release of the R_2 group occurs near islands downriver of the dam. At the February 6, 2012 SRWG meeting, concern was expressed that this release occurs in an equal distribution across the river, rather than attempting to mimic natural migration patterns. Therefore, it is unlikely that mortality will be equal between release groups and that these releases represent mortality of the run-at-large.

General Comments on 2010 Acoustic Tagging Studies

Acoustic tagging studies have a number of limitations that seriously affect their ability to predict the effects of project operations on the survival of juveniles through the entire

hydrosystem. FPC has expressed particular concern over the rejection of fish for tagging (FPC Memos June 24, 2009, March 24, 2011, and February 15, 2012). In 2010, 16% of fish were rejected for tagging. Of rejected fish, 19% were rejected because of size, mostly subyearling Chinook and Steelhead. There are a number of conditions that can cause rejection other than size, including disease and body injury. The largest numbers of fish were rejected due to descaling (22% of rejected fish). The large numbers of rejected fish mean that survival estimates do not represent the run-at-large, but instead survival estimates for the largest, least injured and healthiest 84% of migrants. A study that accurately calculates survival estimates for the overall population will reject fewer fish due to size or condition.

Project survival estimates are a function of survival of individual passage routes and the number of fish migrating through that route. The rate at which fish travel through different passage routes may be affected by acoustic tags. If tags effect migration behavior, the survival estimate will not accurately reflect the survival estimate of the run-at-large. This issue has been discussed by FPC Memos on June 24, 2009 and February 15, 2012. Additionally, there is extensive transport of tagged fish to release sites via trucks. The effects of long trucking times on fish behavior is not considered in this study, but may have significant effects on passage behavior.

The limited life of acoustic tags means they can only accurately assess survival over very short reaches over a short period of time, while the different life stages of salmonids cover a large area and many years. An increasing body of evidence indicates that dam passage affects survival well into the estuary and ocean, and that at-dam survival estimates do not fully represent impact of hydrosystem operations on adult returns (Schaller and Petrosky 2007, Petrosky and Schaller 2010, Tuomikoski et al. 2010, Haeseker et al. 2012). Acoustic tags are unsuitable for evaluating the effects of project passage through the entire hydrosystem, including delayed mortality due to route passage or the cumulative effects of multiple projects.

In previous analyses of acoustic tagging studies, the rejection of some fish detections has occurred during the post-hoc data selection (FPC Memos July 29, 2010, and February 16, 2011). If this type of data rejection was utilized in 2010 performance testing, it is not explicit in these reports. A comprehensive and publicly accessible database of the detection data would allow for more comprehensive analyses of these data.

The limitations of specifically these reports, and of acoustic tagging in general, indicate that project operations should not be made solely on the results of these types of studies. An appropriate decision making framework should incorporate multiple types of data, including those that can provide information on the long-term results of project operations such as delayed mortality. For a detailed discussion of this topic, please see FPC Memo February 16, 2012.

References

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MEMORANDUM

TO: Erick VanDyke, ODFW

FROM: Erin Cooper

DATE: September 11, 2015

RE: SRWG evaluation of performance testing at Bonneville Dam

On July 29, 2015, I attended a meeting of SRWG regarding performance testing at Bonneville Dam. Gary Fredricks (NOAA) provided a list of questions to direct the discussion of what years and operations will be considered having met performance standards. The answers to these questions will determine what additional performance tests will be required at Bonneville Dam, and what operations those tests will be conducted under. At your request, I have summarized responses to these questions using the discussion at the meeting, as well as additional documentation and analyses provided since the start of acoustic tagging at Bonneville Dam.

Not all documentation for this meeting was made available to SRWG members who called into the meeting, rather than attending in person. However, using draft and final reports from performance testing, I have been able to respond to most of the questions presented to SRWG.

1. *What are the final results for the 2010, 2011, and 2012 studies? There are several versions of survival and standard errors in the documents that have been prepared.*

   This comment refers to a document, compiled by the COE, which was distributed to a subset of SRWG members and, according to SRWG members at the meeting, contained multiple errors when compared to the final reports. Although I did not see this document and a copy has not been made available, I have used the official final reports of performance testing to provide the following summary:

Species	Year	Single-Release	Adjusted Survival	Precision
Yearling Chinook	2010	0.9519	NA	0.0040
Yearling Chinook	2011 (full season)*	0.9584	0.9597	0.0176
Yearling Chinook	2011 (early season)*	0.9569	1.0086	0.0042
Yearling Chinook	2011 (late season)*	0.9807	1.0023	0.0447
Steelhead	2010	0.9450	NA	0.0043
Steelhead	2011 (full season)*	0.9491	0.9647	0.0212
Steelhead	2011 (early season)*	0.9527	0.9755	0.0180
Steelhead	2011 (late season)*	Not Provided	Not Provided	Not Provided
Subyearling Chinook	2010	0.9580	NA	0.0055
Subyearling Chinook	2012	0.9694	0.9739	0.0069

*In 2011, spill levels exceeded target operations in the second part of the study. The early season, when operations were within FOP plans, ran from April 30 – May 13. The late season ran from May 14 – May 31.

There is a need for transparency in this process, and the COE should not distribute information for review to only a subset of SRWG. In addition, all information should be checked for accuracy prior to distribution if it is being used as part of the decision-making process.

2. *Are any of the 2010 single release estimates acceptable for performance standards, particularly the subyearling estimate (since it was above the standard)?*

   The 2010 survival studies at Bonneville Dam were not conducted as performance tests, but were instead intended as a pilot study for compliance testing in 2011. Outlined in the 2010 report are a number of constraints that keep 2010 operations from being directly comparable to later passage seasons, including the fact that (1) flows were not accurately measured through non-turbine passage routes, and (2) sluiceway gates were not fully functional. Additionally, the Corner Collector, which spills 5 Kcfs, was not fully functional because the adjacent turbine (Unit 11) was not operational during the 2010 passage season. Therefore, Bonneville operations and passage conditions during 2010 are not representative of subsequent testing or future operations and should not be included as part of the decision-making process regarding performance testing.

   If the 2010 results are accepted for subyearling Chinook, in spite of the shortcomings described above, then results from yearling Chinook and steelhead must be considered a failure, since those single release estimates did not meet the survival standard. However, a serious shortcoming of the performance standards testing program is that requirements for projects that fail performance testing are unclear. Gary Fredricks (NOAA) stated that projects should be required to make improvements for fish passage if standards are not met. However, multiple tests have failed to meet performance standards throughout the system and have resulted only in repeated testing in an attempt to meet the standards with desired operations.

3. *The steelhead estimate from 2011 was slightly under the standard, can it be accepted?*

   Steelhead survival estimates provided for the full testing period and the early testing

period meet the performance standards. However, *yearling Chinook* estimates in 2011 are below the standards (I believe this is what Gary Fredricks intended to reference in this question and what I will respond to).

The performance standards, as written, are clear that a concrete survival of 0.96 is required to meet the standard. No language has been proposed, or accepted, on what would constitute "slightly under" the standard such that it should still be considered as an achieved standard.

The study design for measuring dam passage survival includes a number of weaknesses, including size constraints on tagging, artificial inflation of survival rates when tailrace mortality is high, and the exclusion of delayed mortality associated with dam passage (Appendix A). Given that performance tests as conducted are likely inflating survival estimates, fisheries managers should be as conservative as possible when accepting results that do not meet the standards.

4. *The 2011 standard errors for both steelhead and yearling Chinook exceeded the 0.015 limit, does this disqualify both from consideration?*

   Again, given the weaknesses and concern regarding the performance standards testing, accepting estimates that do not meet the stated criteria is not appropriate. In 2012, the precision of the steelhead survival estimate exceeded the 0.015 limit. However, PNNL and the COE proposed that the standard be accepted as met regardless, because the point estimate of survival was high (>100%). In contrast, the point estimate of survival for yearling Chinook in 2011 did not meet the point estimate standard for survival, and the steelhead estimate was only slightly above the minimum standard. These low point estimates, combined with high uncertainty, do not meet a reasonable standard for acceptance.

5. *The 2012 subyearling Chinook estimate was above the standard, however, spill levels were far above the target operation (average near 150 kcfs), can this result be accepted and at what future operation?*

   The 2012 NOAA report *Federal Columbia River power system juvenile dam passage perfor-mance standard and metrics* contains a clear outline of how to proceed when test operations differ from the planned operations:

   > "To ensure future spill levels provide expected performance over the long run, mean actual spill levels during the two successful test years will be compared to the targeted spill levels at each dam. If the difference between targeted and mean actual spill is within a variance of 5 percent (absolute) or 5 kcfs for Snake River projects and 10 kcfs for Columbia projects that spill at a flat rate, then mean target spill levels will not be adjusted. If after a second year of otherwise successful testing, actual spill is greater than this criteria, the AAs with NOAA Fisheries concurrence, may elect to accept the highest actual spill level minus 5% (or 5 kcfs for

Snake River dams and 10 kcfs for Columbia River dams) *OR* an average of the two actual spill levels under which the two successful tests were conducted as the new target spill level to attain juvenile performance standards. Alternatively, to be determined on a case by case basis, the AAs with NOAA Fisheries concurrence may elect to either conduct additional testing at the original target spill level or adjust future target spill levels by the amount exceeding the acceptable variance as stated above."

Given the procedures outlined by NOAA, the operations accepted after performance testing will depend on whether results from 2010 are accepted. In 2010, actual operations exceeded planned spill levels during part of the testing period.

6. *If results of any year of testing are accepted as passing, does rejection of other results from that same year of testing (same methods) constitute a failure to meet the standards for those species? (e.g., 2010 acceptance of subyearling estimate and rejection of yearling and steelhead estimates.)*

   Yes, see above (#2).

7. *Do any failures to meet standards in past tests require reconsideration of the Bonneville Project configuration for juvenile fish passage?*

   Performance testing at Bonneville Dam has failed to meet performance standards for yearling Chinook and Steelhead in every year of testing. Rather than simply retesting, all options for juvenile survival, including increased spill, should be considered to maximize juvenile survival and increase adult returns. As described in the 2012 NOAA report *Federal Columbia River power system juvenile dam passage performance standard and metrics,* performance testing should clarify the need for operational and configuration improvements.

8. *Do the Action Agencies anticipate averaging test results across projects to meet the standards and how will this be accomplished?*

   Although averaging performance standards results has been repeatedly discussed in SRWG, a specific methodology for this has not been proposed. It is unclear if the averaging of survival estimates would occur across dams and/or years, and how precision estimates would be incorporated into that average.

   Yearling Chinook survival has not met the standard at Bonneville Dam in either 2010 (single release) or in 2011 (adjusted survival) so it is unclear how averaging survivals between years at Bonneville Dam would achieve any management goals. Similarly, the average of Steelhead survival between 2010 and 2011 is 0.9549, which is below the standard of 0.96. The precision estimate from 2011 exceeds the standard, for both species, and so an average of point estimates of survival is an inappropriate way to manipulate the data.

Appendix A

FPC Memos and Joint Technical Staff Memos Regarding Performance Testing

June 24, 2009 - http://www.fpc.org/documents/memos/91-09.pdf
July 29, 2010 - http://www.fpc.org/documents/memos/93-10.pdf
February 16, 2011 - http://www.fpc.org/documents/memos/20-11.pdf
March 24, 2011 - http://www.fpc.org/documents/memos/37-11.pdf
June 21, 2011 - http://www.fpc.org/documents/memos/91-11.pdf
February 15, 2012 - http://www.fpc.org/documents/memos/11-12.pdf
March 16, 2012 - http://www.fpc.org/documents/memos/25-12.pdf
March 23, 2012 - http://www.fpc.org/documents/memos/31-12.pdf
January 4, 2013 - http://www.fpc.org/documents/memos/02-13.pdf
February 11, 2013 - http://www.fpc.org/documents/memos/15-13.pdf
March 19, 2013 - http://www.fpc.org/documents/memos/32-13.pdf
March 22, 2013 - http://www.fpc.org/documents/memos/44-13.pdf
October 7, 2013 - http://www.fpc.org/documents/memos/120-13.pdf
December 3, 2013 - http://www.fpc.org/documents/memos/138-13.pdf
January 14, 2014 - http://www.fpc.org/documents/memos/05-14.pdf
January 21, 2014 - http://www.fpc.org/documents/joint_technical/07-14.pdf
January 27, 2014 - http://www.fpc.org/documents/memos/10-14.pdf
January 27, 2014 - http://www.fpc.org/documents/joint_technical/21-15.pdf
May 2, 2014 - http://www.fpc.org/documents/memos/60-14.pdf
February 3, 2015 - http://www.fpc.org/documents/memos/25-15.pdf
February 20, 2015 - http://www.fpc.org/documents/memos/33-15.pdf
February 20, 2015 - http://www.fpc.org/documents/joint_technical/34-15.pdf
June 8, 2015 - http://www.fpc.org/documents/memos/92-15_rev1.pdf
June 8, 2015 - http://www.fpc.org/documents/joint_technical/96-15.pdf