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MEMORANDUM

TO: FPAC

FROM: Michele DeHart

DATE: February 25, 2014

RE: Review of IDFG Change Form for Ice Harbor Dam Spring Spill Operations in 2014

In response to your request, the Fish Passage Center (FPC) staff has reviewed the proposed IDFG change form for modified spring spill operations at Ice Harbor Dam (IHR) in 2014. Under the 2014 Biological Opinion, spill for fish passage at IHR between April 28th and July 13th alternates between 30%/30% and 45 Kcfs/Gas Cap, generally every two days. The IDFG change form proposes to modify spill during this period to a constant spill level, with a volume that would approximate an average between these two operations. The FPC staff has modeled the impact of the proposed modified spill operation on the provision of spill during the April 28th to July 13th period. Below is a summary of our findings, followed by a detailed discussion of the analyses conducted for this review.

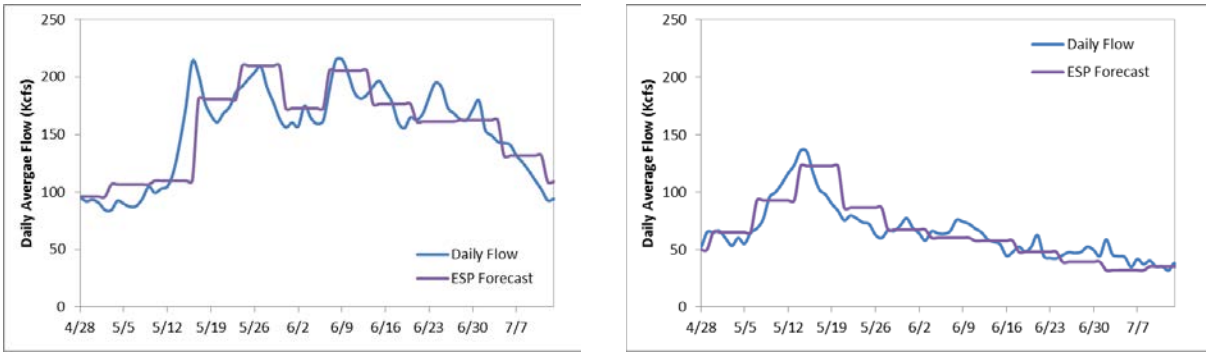
- Compared to the other Snake River projects, hydraulic capacity at IHR is relatively low. With this low hydraulic capacity, it is unlikely that spill under either condition would fall below 30%.
- In general, the IDFG proposal will eliminate the periods when daily average spill at IHR is 30%. However, the IDFG proposal also eliminates the periods when daily average spill at IHR exceeds 70%, which occur fairly frequently in low to medium flow years.
- As part of its justification, the IDFG proposal cites increases in spillway passage of Chinook and steelhead due to the elimination of 30% spill at IHR. However, the change form fails to recognize that eliminating the periods of 70%–80% spill could reduce spill passage of Chinook and steelhead.

Methods

Under the IDFG proposed change form, spill at IHR during the period of April 28th through July 13th would be as follows:

> *"…On April 28, the US Army Corps of Engineers Walla Walla District (COE) will use the ESP flow forecast for Ice Harbor Dam to estimate a forecasted weekly average flow. The COE will use the weekly average flow forecasts to estimate an average daily spill volume that would occur under both the 45 Kcfs day/gas cap night and then the 30% per day operations. The COE will then calculate the weekly constant spill volume to be provided at Ice Harbor Dam by averaging these two estimated spill volumes. If the actual flow or flow forecast changes significantly during the week, the COE would notify the Technical Management Team Members of the change, and recalculate and provide a constant spill volume intended to provide the same overall spill volume as would occur on average with the alternating spill operations. This spill operation will continue until July 13 at 0500 hours, then 45 kcfs day/Gas Cap night through August 31.*

In order to model spill under the IDFG change form, the FPC staff needed the weekly ESP flow forecasts from past years. We were able to get these ESP flow forecasts for two flow years: 2011 and 2013. Modeling these two flow years enabled us to investigate the impacts of the IDFG change form in a high flow year (2011) versus a low flow year (2013). Figure 1 shows actual flows for each of the years we modeled, as well as the weekly average flows from the ESP forecasts for those years.



2011 **2013**

Figure 1. Average daily flow (Kcfs) at Ice Harbor Dam and weekly average predicted flows from ESP forecast in 2011 and 2013 (April 28–July 13)

For comparison, we modeled spill at IHR using the actual spill schedules that were used in each of the two years and as it would have occurred using the IDFG proposal. Under both scenarios, the following assumptions were made when modeling: (1) hydraulic capacity was 83.8 Kcfs

(based on actual capacity in 2011), (2) powerhouse minimum was 10.5 Kcfs, and (3) gas cap spill was 92 Kcfs (when not limited by flows).

Results

Modeling efforts revealed two general impacts of the IDFG proposal. First, in the two years we modeled, the IDFG proposal eliminated all days where daily average spill at IHR was 30% (Figure 2). However, the IDFG proposal also eliminated all days where the daily average spill proportion at IHR exceeded 70% (Figure 2).

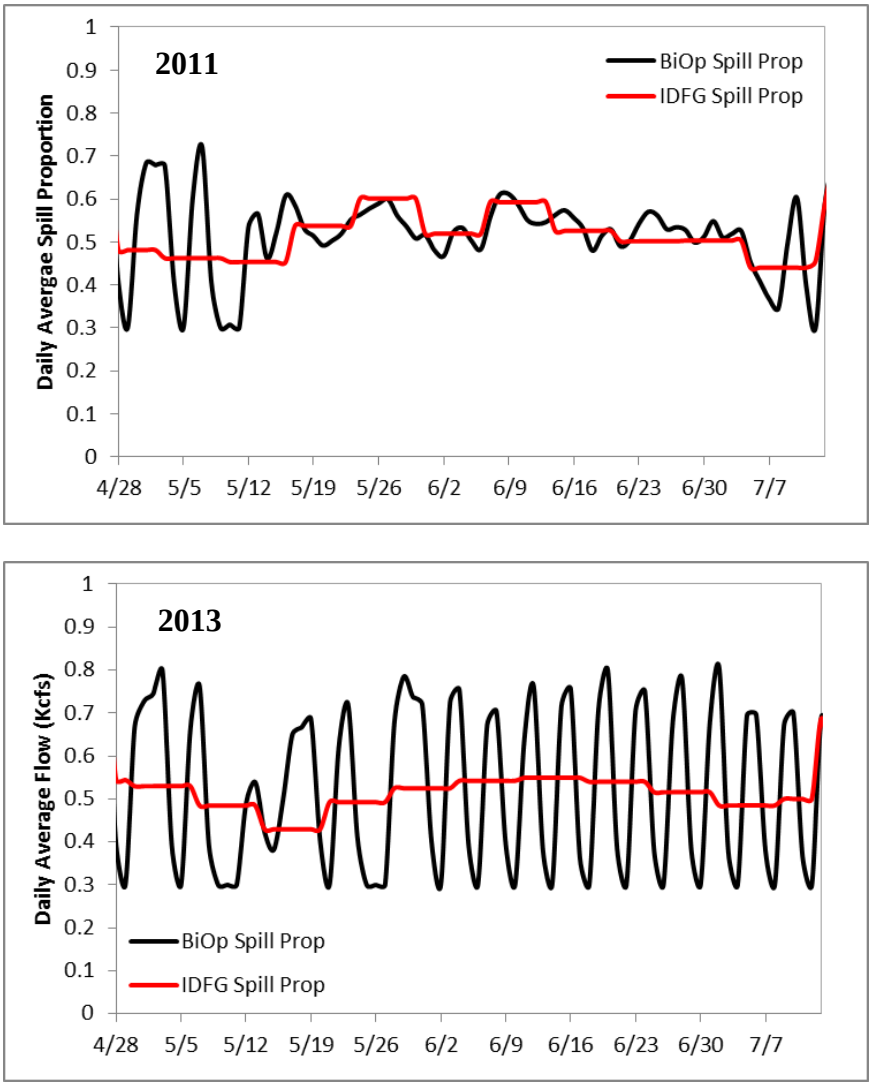


Figure 2. Modeled results (daily proportion spill) of BiOp Spill (black) versus proposed IDFG change order (red) during April 28-July 13 period.

Discussion

The draft IDFG change form for Ice Harbor Dam offers the following justification:

> *"After four years of research at Ice Harbor Dam, NWFSC Biologists concluded that for yearling Chinook salmon and steelhead trout, spill percentages less than 37% and 39% (respectively) appear to not effectively shift fish away from the powerhouse, while spill levels higher than 48% and 53% (respectively) appeared to have decreasing effectiveness in shifting fish away from the powerhouse."*

This statement is based on Axel et al., 2010, but we believe the research was incorrectly interpreted and consequently the justification appears to be in error.

Axel et al., 2010 state:

> "*We have been evaluating fish passage at Ice Harbor Dam with respect to operation of an RSW for 4 years. As a result, we have data from a large number of fish that have passed under variable levels of percent spill. Regressions were plotted for percentage of fish that passed vs. percentage of spill for yearling Chinook salmon (n = 6,663), juvenile steelhead (n = 6,325), and subyearling Chinook salmon (n = 6,360; Figure 20). Results identified various operating points, in terms of percent spill, where project operation might influence fish passage distribution. For yearling Chinook salmon, spill percentages greater than 37% appear to shift fish away from the powerhouse, but levels higher than 48% appeared* ***to decrease the effectiveness of the RSW****. Similar respective beneficial and detrimental operating points were identified at approximately 39 and 53% spill for steelhead, and 45 and 59% spill for subyearling Chinook."*

The authors reiterate the impact of increasing spill on the effectiveness of the RSW in the discussion of the paper stating:

> "*There also exists a point of diminishing returns, where additional spill reduces the overall effectiveness of the RSW, as well as the spillway as a whole.*"

However, while the data seem to indicate that the overall effectiveness of the RSW decreases as more spillbays are used (i.e., increased spill), there is no information supporting the reduction of the effectiveness of the spillway as a whole. This statement is likely what lead to the misinterpretation in the justification for the change form.

Figure 3 (below) was taken from Axel et al., 2010, to illustrate the decrease in effectiveness of the RSW with increasing spill. However, the graphs also show that the benefit of non-RSW spill increases at higher spill levels. The graphs also show a flat area for Chinook powerhouse

passage, but powerhouse passage does decrease with spill at higher spill levels, and decreases at lower spill levels for steelhead and subyearling Chinook.

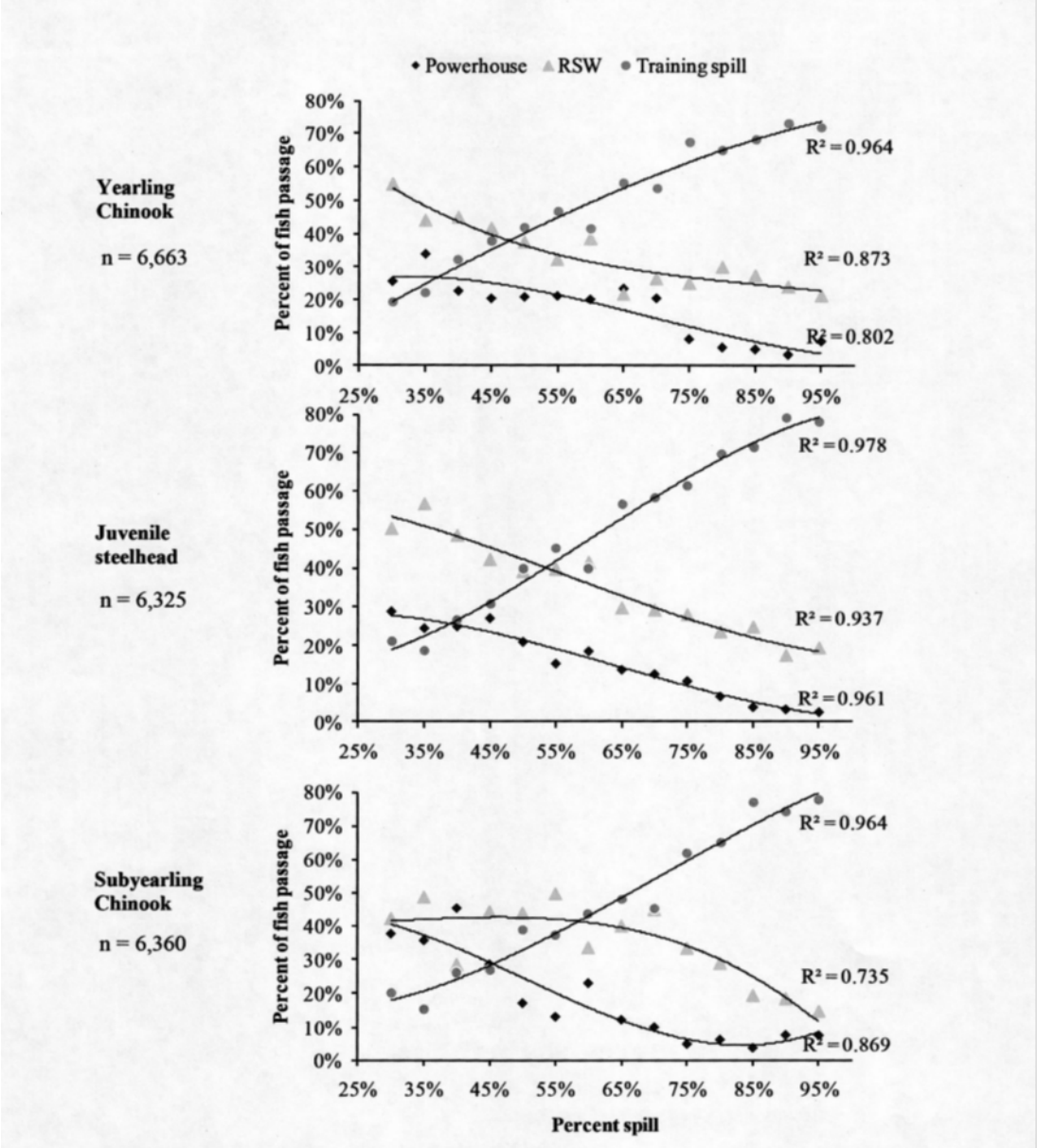


Figure 3. : Percent of radio-tagged yearling Chinook salmon, juvenile steelhead, and subyearling Chinook salmon passing via the powerhouse, RSW, and training spill during varying levels of percent spill at Ice Harbor Dam, 2006–2009. Originally Figure 20 from Axel et al. (2010).

At the February 18, 2014, FPAC meeting the following graph (Figure 4) was shared by NOAA. This graph appears to summarize the training plus RSW spill passage efficiency for Chinook as a function of spill proportion. The graph is forced to a zero SPE at zero spill and 100% SPE at 100% spill, and is then fitted with a second order polynomial. The effect of fitting the graph through 0 is to produce a very sharp increase in SPE where no data exist (0%-30% spill). However, the graph does show that SPE increases at the higher spill proportions.

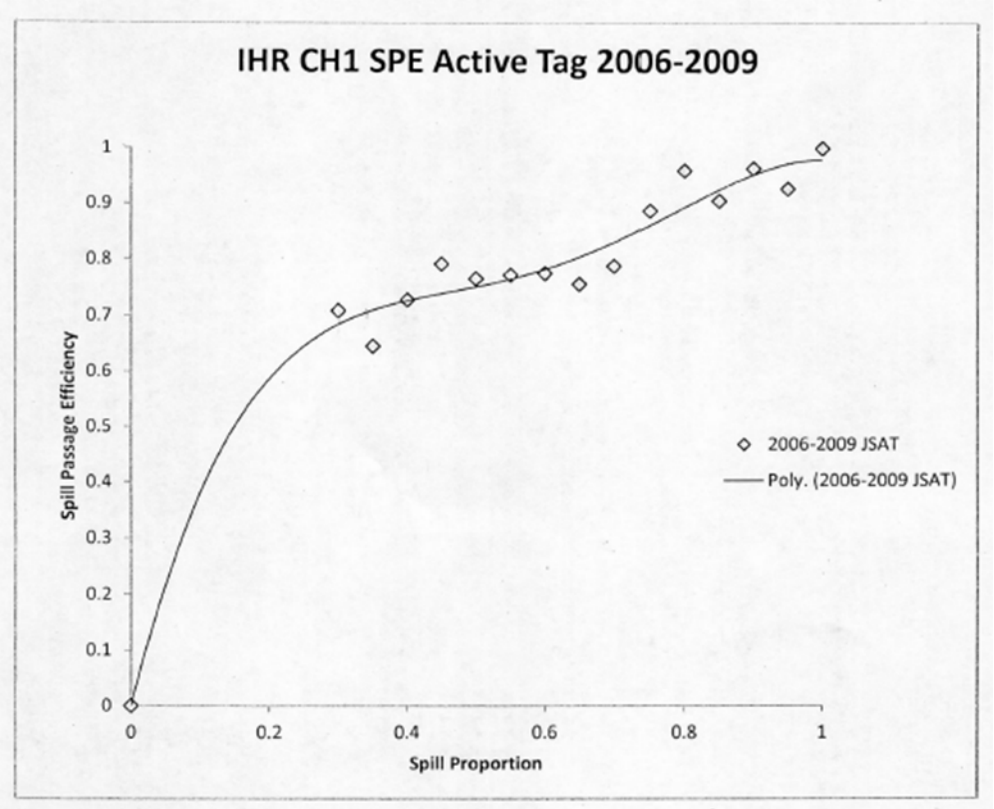


Figure 4. Example of Spill Passage Efficiency curve for IHR based on multi-year, active tag data from 2006–2009. Figure was provided by NOAA to FPAC during February 18, 2014 meeting

In summary, the proposed draft change form for Ice Harbor Dam assumes that there are limited benefits to the high spill levels that currently occur under the 45 Kcfs/Gas Cap treatment that the BiOp provides. While we agree that alternating between 30%/30% and 45 Kcfs/Gas Cap "treatments" is less than ideal, we do not agree that providing a weekly constant spill volume that averages these two treatments is warranted. As mentioned above, a weekly constant spill volume that averages what would have occurred under the two spill operations may not increase the proportion of Chinook and steelhead smolts that pass Ice Harbor Dam via the spillway as anticipated and may actually lead to an overall decrease in spill passage, particularly in low flow years like 2013.

Literature Cited:

Axel, G.A., E.E. Hockersmith, B.J. Burke, K. Frick, B.P. Sanford, W.D. Muir, R.F. Absolon, N. Dumdei, J.J. Lamb, and M.G. Nesbit. 2010. Passage behavior of radio-tagged yearling and subyearling Chinook salmon and juvenile steelhead at Ice Harbor Dam, 2009. Report by National Marine Fisheries Service to the U.S. Army Corps of Engineers Walla Walla District, Seattle, Washington, Contract W68SBV83306729, 71 p.