FISH PASSAGE CENTER

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MEMORANDUM

TO: Penny Becker, WDFW
SRKW Task Force

FROM: Michele DeHart, FPC

DATE: September 14, 2018

RE: Written response to questions from the Southern Resident Killer Whale Task Force

The following memorandum provides written responses to twelve specific questions posed by the SRKW Task Force. Review of the questions indicated that it might be most helpful to provide a brief historical context of spill for fish passage at mainstem hydroelectric projects. This could provide background for the answers to the specific questions and also provide some understanding of how the region arrived at the present point regarding the importance of spill for fish passage at mainstem hydroelectric projects.

The present proposals to increase the present 24 hour per day, spill for fish passage to the 125% dissolved gas cap at tailraces of mainstem dams are the result of a long continuum of research, data, analyses and implementation of programs, operations and experimental structures, beginning in 1981, to reduce juvenile salmon powerhouse encounters. Through the 1980s and 1990's extensive and expensive efforts were made to reduce powerhouse passage of juvenile salmon without increasing spill for fish passage. Although spill for fish passage was shown to be the safest passage route for juvenile salmon, regional efforts were focused on limiting spill for fish passage, to avoid reducing the revenue generating potential of the fully developed hydrosystem.

These efforts included many years of the development and deployment of turbine screens, juvenile fish collection systems, structural devices to guide fish away from turbine units, surface spill structures. Implementation of special hourly operations and schedules of limited spill were attempted.

The effectiveness of these efforts to avoid powerhouse encounters without provision of spill for fish passage was defined by the listing of almost all populations of Snake River salmon as threatened or endangered in 1991. The NOAA Biological Opinion included Reasonable and Prudent alternatives for salmon passage which included spill for fish passage. Over the subsequent years challenges regarding the adequacy of the Biological Opinions resulted in Federal Court orders which increased spill for fish passage.

Decades of gas bubble trauma monitoring have shown that spill for fish passage can be increased to the 125% tailrace gas cap, without adverse impacts to migrating salmon.

1. **What is spill – describe what it is and why it benefits salmon**
   Spill is a proportion of river flow which passes over the spillway instead of through the powerhouse. Juvenile salmonids follow the flow. Higher proportions of river flow through the spillway, results in higher proportions of downstream migrants passing over the spillway. Fish that pass over spillways have higher juvenile survival, faster downstream migration travel time, higher first year ocean and estuary survival rates, and higher smolt-to-adult return rates.

   Passing through powerhouses, whether through the turbines or juvenile screened bypass systems, causes direct injury, mortality, delay and lower survival in later life stages, lower first year ocean and estuary survival and corresponding lower smolt to adult return rates. Current analyses indicate that spill for fish passage is one of the most important environmental variables affecting survival to adult.

2. **Does timing of spill matter day/night and can spill be pulsed 4 hours spill /4 hours energy or some other scenario to compromise /balance power generation with fish needs?**
   No, these various operations, pulsing and others have been addressed over the past decades. At the present time the implementation of spill is 24 hours per day, based upon 37 years of research and analyses regarding implementation of spill for fish passage. Various spill operations have been implemented over the decades since the completion of the hydrosystem, including limited night time hours, no daytime spill, sequential turbine operations, various night time schedules and no daytime spill, have all been implemented. Pulsing, ponding and other hourly manipulations of powerhouse operations have been shown to increase juvenile fish passage through powerhouses. In addition these operations are difficult for power operators to implement and market.

3. **Can spilled water be from deep in reservoirs to provide cooler water?**
   Juvenile spring Chinook typically out-migrate from late-March to the end of May prior to the onset of warm temperatures. Adult spring Chinook return at a similar time period, thus avoiding much of the warm water temperatures that cause delay and mortality in later migrating salmon populations.

   Larger flood control reservoirs like Dworshak can release flow at depths where water is cooler, there is no juvenile fish passage at Dworshak Dam.

   Spill for fish passage presently being discussed in terms of increasing juvenile survival and increasing smolt to adult return of spring Chinook for Orca forage applies to run of river projects that do not have large storage reservoirs, have fixed depth spillways and generally do not have a high degree of temperature stratification. Removal of the four lower Snake River dams will reduce river water temperatures.

4. **Are there alternatives to increasing flow, like solar, wind, other sources of energy to offset lost energy production?**
   Spill for fish passage does not require any increase in flow or additional water releases from upstream storage reservoirs. Increasing spill for fish passage to the 125% gas cap spill level increases the proportion of river flow passing over the spillway instead of the powerhouse. Increasing spill to the 125% gas cap spill level for fish passage does not affect the river flow.

   One of the objectives of the Orca task force is to increase potential forage in early spring of adult Columbia/Snake spring Chinook off of the mouth of the Columbia River. Columbia/Snake spring chinook migrate downstream through the power system primarily in March, April and May, when spill to the 125% gas cap would decrease their power house encounters. In most years, spill in April and May has less revenue impact because power is less valuable, when flow is abundant and load demand is less. Solar and wind power are increasingly becoming the primary power source, presently changing the dynamics of energy demand, production and reliance on the hydrosystem to provide base load.

   As a point in history, as the energy system changes to green solar and wind, it is an opportunity to include fish needs in planning the energy future of the region. In the late 70's and 80's the energy system had been designed and was operating without consideration of fish needs. This moment in history presents a new opportunity to incorporate salmon passage needs into system planning.

5. **Are there structural modifications to the dams that would increase survival without the need for spill and the safe passage it provides?**
   No, there are not. As described above in the introduction, the region spent decades attempting modifications in structures and modifications to provide safe fish passage without spill and they did not work. The region has expended significant funds and time on these structures for decades, to mention a few: vertical barrier screens, travelling screens, bar screens, sluiceways, forebay booms, forebay curtain, forebay nets, lights, complicated turbine bypass systems, smolt transportation facilities and structures, barge loading and trucking facilities, removable and temporary spillway weirs even bypass channels. Decades of doing everything except spill for fish passage have brought the region to this point. Several federal court decisions have ordered spill for fish passage based upon decades of research and analyses. After pursuing all non-spill options it is clear that there are only two options left for the region, increase spill to the 125% gas cap and/ or remove the four lower Snake River dams.

6. **Are survival increases the same for the Snake River and Columbia River dams or is spill needed at only some of the dams?**
   Spill to the 125% gas cap is needed at all of the Columbia and Snake rivers dams. It is important to recognize that the juvenile migration of Snake River spring chinook is a continuum throughout their downstream migration through 8 dams from the Snake River to below Bonneville dam. Spill must be provided at all 8 dams with the objective of having the lowest possible number of powerhouse passages to increase the number of adult spring Chinook returning to the Columbia /Snake River basins (forage for Orcas).

7. **How much revenue is lost with spill at the current court ordered level relative to pre-spill requirement?**
   Bonneville Power Administration or the Northwest Power Planning Council are the appropriate entities to develop estimates of reduction in potential revenue from implementing spill for fish passage. However, increasing Columbia/Snake rivers adult spring Chinook for forage for Orcas requires increased spill for fish passage for spring Chinook juveniles migrating downstream primarily in April and May, when power demand is lower, flows are higher and power market prices are lower. Over generation spill or lack of power demand spill occurs in these same spring months when lack of market demand forces increased spill. In most years spill in the spring months has less potential for impact to power markets.
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8. **What are the impacts to power production, irrigation, and transportation with spill?**
   The region has been managing spill for fish passage with power production, irrigation and transportation and spring spring spill since 1981. As spill for fish passage mitigation measures changed, regional operations entities managed those changes within their

mandated responsibilities. A management process is in place in the region in which power managers, fishery managers, flood control and project managers collaborate to implement spill for fish passage. Spill at mainstem projects does not affect water withdrawals for irrigation, because spill at mainstem projects only changes the proportion of river flow passing through spillways relative to powerhouse flows. Increasing spill to 125% will not impact water supply for irrigation or impact river transportation. Management systems are in place, regionally and at individual projects that incorporate transportation, power and irrigation concerns. The management systems required to implement spill for fish passage at the 125% gas level spill are the same as the management systems in place at the present time for implementation of the current 115%/ 120% dissolved gas cap spill for juvenile salmon passage. For example, spill may be curtailed in some circumstances for a brief period of time to allow barge approach to locks at mainstem dams. Bonneville Power Administration or the Northwest Power Planning Council can generate estimates of potential power revenue. However, increasing spill for fish passage in April and May to increase spring Chinook (Orca forage) occurs in a period when over generation and lack of load spill occurs, and when flows are higher and power demand is lower in most years.

9. **Why does spill cost so much?**
   Spill is not an actual cost. Spill reduces the amount of revenue that is generated from river flow through the powerhouses. It reduces the potential revenue generated by the power system. The Northwest Power Act specifically recognizes that generation of power revenue is not the sole purpose of the Columbia and Snake rivers. Increasing spill in spring months to increase spring Chinook survival (Orca forage) is the time period in which increasing spill is the most economical in most years.

10. **Will the Columbia River treaty with Canada include benefits of for salmon regarding spill?**
    To date the Columbia River Treaty has not included consideration of spill for fish passage. The US entities in the Columbia River Treaty are the Bonneville Power Administration and the U.S. Army Corps of Engineers. The US entity could be consulted to request details of treaty negotiations including inclusion of spill for fish passage.

11. **Can smolt to adult return (survival) be high enough with spill to "eliminate" the need for breaching the four lower Snake River dams?**
    Analyses of implementation of the 125% spill for fish passage scenario, based upon historic ocean and river conditions indicate that the 2% - 6% smolt to adult return rate (to rebuild populations) is achievable with the 125% gas cap spill. However, if future ocean conditions and or river conditions such as flow and river water temperatures degrade due to climate change, removal of the four lower Snake River dams will provide the greatest assurance of meeting the regional SAR goals. However, the 125% gas cap is

implementable immediately, while removal of the four lower Snake River dams, requires more time as it is pursued for the future.

12. What is gas bubble trauma? Is this a concern if you spill more?

No. Spilling to the 125% dissolved gas cap is not a concern for fish safety. Gas bubble trauma is the result of exposure of fish to nitrogen/oxygen supersatured water. Deep plunging water over spill ways can cause gas supersatured water. The dissolved gas, much like the bends in scuba divers, comes out of solution in the fish's blood stream causing bubbles or embolism. These can cause injury and death if severe. Over the decades, gas bubble trauma has been studied in the Columbia River. For over 20 years a gas bubble trauma monitoring program has been in place and data has been collected consistently. NOAA fishery has established conservative action criteria that are included in this monitoring program. Data from the gas bubble trauma monitoring program have been collected over a large range of total dissolved gas levels, including levels as high as 140%. These levels of total dissolved gas typically occur during periods of over generation spill in very high flow years. The monitoring data collected over the past decades indicate that spill at the 125% gas level in the tailrace is safe for juvenile salmon migrating downstream.