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MEMORANDUM

TO: Chad Brown, WA Department of Ecology
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FROM: Margaret Filardo, Ph.D.

DATE: July 18, 2013

RE: Meeting with DOE on June 27, 2013

The purpose of this memorandum is to provide a written response to the technical questions that were discussed at our June 27, 2013, meeting. The meeting was held in response to your request to discuss in detail the technical development of the spill scenarios that were used in the Comparative Survival Study (CSS) prospective modeling of hydrosystem fish passage conditions and resulting prediction of adult return rates. These CSS analyses were presented to the region at the CSS Annual Review meeting on April 30, 2013. The June 27th meeting was also attended by Theresa Scott (WDFW) and Agnes Lut (BPA). Since the identified objective of the meeting was to provide responses to technical questions, this memorandum provides focus on the technical questions discussed at the June 27 meeting, and does not address the various policy issues that were contemplated at the meeting.

Have spill analyses and data been updated since the 2008 Adaptive Management Team (AMT) process and report? If so, how have the spill data and analyses been updated? In essence, what has changed since 2008?

The CSS spill analyses and data have been significantly updated and improved since the studies that were considered during the 2008 AMT process. The time series of data for physical parameters such as flow, spill, and ocean indices, as well as juvenile and adult fish survival, have been consistently improved each year through comprehensive monitoring and analyses.

In general, the methodology employed to develop the spill proportions for the current CSS analysis was similar to that used for the AMT. However, there was considerable improvement in the determination of the spill caps used to estimate the spill proportions. In the AMT process, the Fish Passage Center (FPC) relied on empirical data to develop the spill caps, while in the

CSS analysis the spill caps used were developed by the Corps of Engineers (COE) for the real time distribution of excess-generation spill at specific TDG levels using the SYSTDG model, and represent the most current hydrosystem configuration. The most recent spill caps are the result of spill and dissolved gas modeling by the COE, which has been refined since the 2008 AMT process. A presentation from the CSS Experimental Management Workshop in March of 2013 was used during the June 27th meeting to answer basic questions about how the analyses were developed. (A report of the workshop proceedings will likely be available this summer and will include information on the development of the spill caps and the issues taken into consideration, such as adult passage concerns.)

Has there been new fish passage and survival information collected since the 2008 AMT process?

The region has made significant investments in research and monitoring since the 2008 AMT process, which have allowed the region to address critical uncertainties regarding previous analyses and the relation between oceanic and riverine processes. Since the 2008 AMT process, all of the PIT-tag smolt-to-adult survival data sets were updated with an additional 5 years of precise juvenile and smolt-to-adult PIT-tag survival estimates. The CSS data time series now allows analysis of data collected from over 15 years. In addition, run reconstruction estimates, incorporating a greater time series of data (40 to 60 years) have been developed and analyzed. This provides additional lines of evidence with a much broader range of environmental contrast. These data sets have been compiled and analyzed retrospectively. All of these analyses document the linking of estuary and early-ocean mortality to the migration experience through the hydrosystem. Spill passage has consistently shown to be an important factor in determining survival to adulthood. In addition, in response to recommendations made at the CSS workshop in 2011, the spill variable used in the analyses has been refined to reflect the current hydrosystem configuration, incorporating the effects of the spillway weirs installed at projects. However, it is important to note that while the recent CSS analyses represent significant improvement utilizing more advanced mathematical and statistical methodologies, the analyses provide results that are consistent with those presented during the 2008 AMT process.

The spill caps which were incorporated into the CSS prospective modeling are very influential in determining the expected benefits of spill to salmon survival. Will these spill caps be challenged or questioned?

There is no doubt that the technical basis of the spill caps used in the CSS prospective modeling will be reviewed. This is consistent with the scientific process. Recognizing this point, the spill caps used in prospective modeling were carefully based upon the available results of monitoring and mathematical modeling. The spill caps that were used in the CSS analysis were taken from the COE's Spill Priority List (prepared 4/11/12) for the distribution of lack of market (excess generation) spill. The spill caps are based on SYSTDG model runs where all projects are simultaneously spilling to the specified gas cap. In order to show how representative of actual data the spill caps used in the analysis were, we graphed the daily average total dissolved gas in the tailrace of each project at each flow level for the representative water years used (2009, 2010 and 2011) in the prospective analyses. As can be seen in Figure 1 and Figure 2, both the 120% and the 125 % TDG spill caps coincide extremely well with the empirical data. The only projects that show a slight variation are Lower Monumental and John Day dams. At Lower Monumental Dam, the reason for this is that the project can employ either a bulk or flat spill

pattern. TDG production is higher using the bulk pattern at the same level of spill. The COE employs the bulk pattern, while above a minimum flow the agencies and tribes would recommend using the flat spill pattern, producing less dissolved gas. Most of the empirical data plotted were collected during the implementation of the bulk spill pattern at Lower Monumental Dam. At John Day Dam there is a band of spill levels (somewhere around 80–120 Kcfs) at which TDG levels are greater than TDG levels that occur at higher spill levels. In the spill experiment, spill would occur at the spill levels greater than 120 Kcfs.

Would a complete understanding of the CSS analyses enhance the understanding of the projected benefits of increasing levels of spill for fish passage?

Yes, this would be helpful since recent fish survival and adult returns analyses have substantially changed and improved our understanding of the effect of hydrosystem passage on adult returns, particularly since the 2008 AMT process. This is particularly true of our improved understanding of the benefits of spill passage to survival at later salmon and steelhead life stages. A complete discussion of these findings could be organized for a later meeting.

Is the objective of experimental spill management the same as the objective of the AMT?

During the AMT process the focus was on the additional amount of water that would be spilled if the 115% forebay requirement was removed. During the process the water quality agencies requested an incremental benefit to fish survival from removing the 115% forebay TDG requirement. While it is understood that the water quality agencies needed specific measurements for their determinations, this forced arguments regarding the additional water volume spilled, rather than focusing on the ability to meet region survival goals for fish as done in the present CSS analyses. That said, in the AMT process there were three different analyses (FPC, COE, and BPA) on the amount of additional spill that would occur if the 115% forebay criteria were removed. Given that there was a question regarding the best operational spill scenario to implement in the near future, the FPC analyses considered the entire breadth of possible changes in survival that could occur under the implementation of alternative spill programs. This provided a broader foundation upon which to see the potential benefits of increases in fish survival using other possible scenarios than just the 2008 Biological Opinion. The COE and BPA focused on the absolute change in the spill volume that would occur if the 115% forebay restriction was removed, assuming the implementation of the BIOP spill levels, and included excess generation spill in their baseline spill volumes. This methodology showed a lesser increase in spill volume and consequently, a very small incremental benefit to smolt-to-adult survival.

The FPC is always cautious when considering excess generation spill in prospective analyses. Excess generation spill occurs when there is no market for the energy produced and water has to be spilled in the system. To explain further, the provision of spill in the 2008 AMT process or in the 2013 experimental design, has to be guaranteed and occur under all conditions in order to accurately assess a fish benefit. This is a “managed” spill program. The only spill levels that are presently guaranteed are the Biological Opinion spill levels, whereas excess generation spill is unpredictable from hour to hour, or year to year. In prospective modeling the FPC considers excess generation spill an economic factor. The cost of a spill alternative is determined by the “immediate” dollar amount that can be applied to foregone energy. If all the generated power could be sold, but spill precludes the sale of a portion of the water, then the cost is in terms of

that amount of foregone energy. If excess generation spill is present in the system and can be used to meet the spill levels without forgoing any sellable energy, then the spill does not cost anything in terms of forgone energy production.

What is the difference between the spill levels used in the retrospective analysis versus the prospective analyses?

Some confusion was expressed relative to whether we were able to predict benefits to fish survival from increased spill under the experimental spill management, when we have already observed spill to those levels as excess generation or excess hydraulic capacity spill. For ease of explanation, the relation between spill and fish survival is discussed as a bivariate relation. (The CSS models are complex statistical relationships developed to predict the effects of environmental factors and management strategies on migration and survival rates of juvenile yearling Chinook and steelhead.) In the retrospective modeling the historic data for fish survival was analyzed, under the range of historic flow and spill conditions, to define the relation between spill and fish survival (again recognizing that the CSS is not a simple bivariate model). The prospective models then estimate, using the developed statistical relations, the survival that would result for a range of experimental spill conditions and a range of environmental conditions. The experimental spill scenario simulations assume that spill is **guaranteed** to occur under all flow conditions and can include excess generation spill or excess hydraulic capacity spill to the extent that it is available, decreasing the cost. The overall survival under the implementation of alternative spill programs is compared to regional goals for fish survival.

In summary, significant new data have been compiled and analyzed since the AMT process in 2008. The emphasis of the CSS spill experimental management is to demonstrate the ability to meet regional fish survival goals under a range of alternative "managed" spill programs. These alternatives are "risk based" and are limited to the 125% dissolved gas level, which can be implemented without exceeding the gas bubble trauma criteria established by NOAA and used for present management. The prospective models presented at the Annual CSS meeting considered the possible alternative managed spill programs, over a range of river flow and ocean conditions. The distribution of projected smolt-to-adult survivals under these conditions were summarized and presented relative to the desired survival goals. This is a realistic method of evaluating our ability to accomplish fish recovery using various recovery strategies, and far more informative and different than the development of an incremental increase in survival as done during the AMT process.

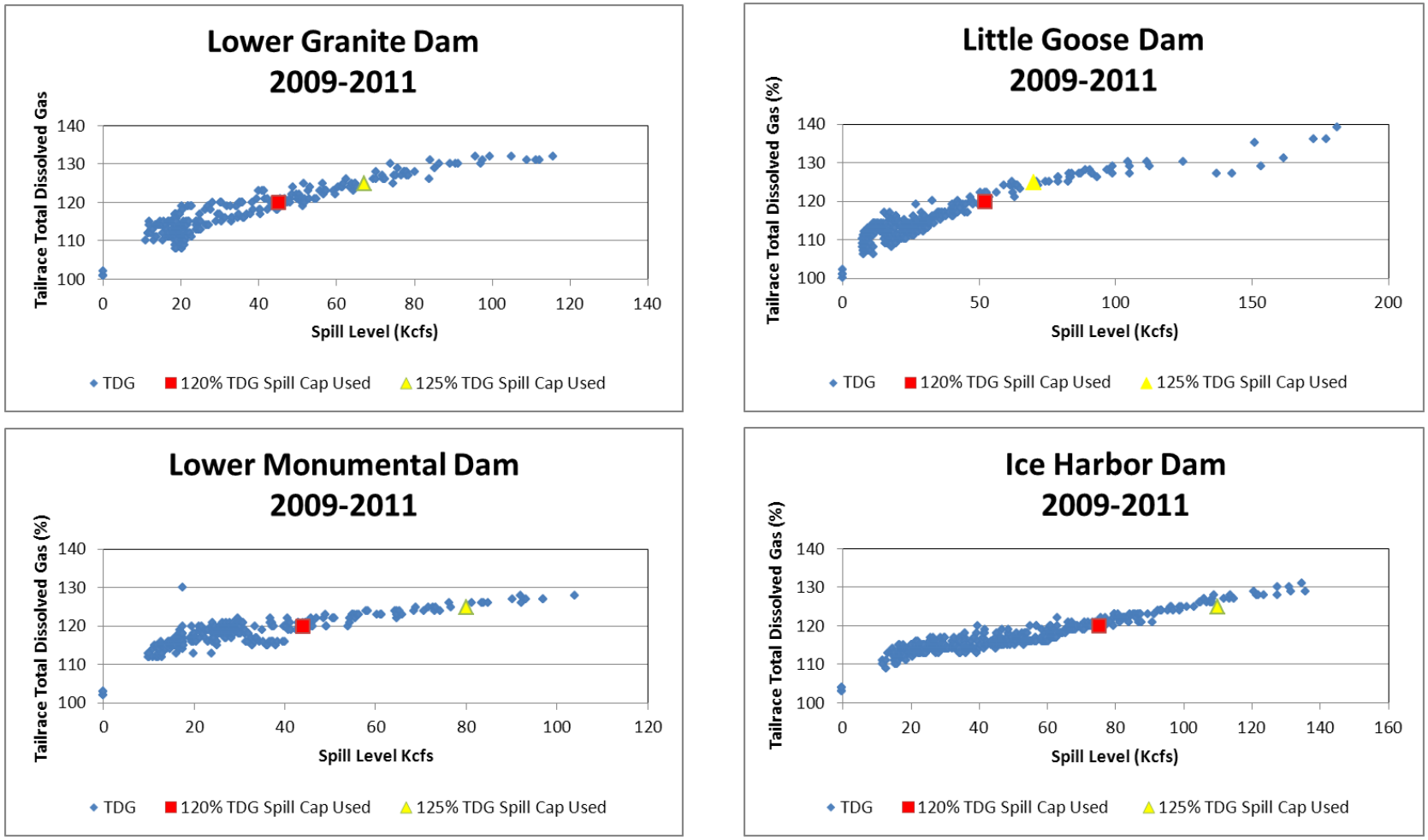

Figure 1. Tailrace total dissolved gas (average of the 12 highest hourly values in a 24-hour period) produced as a function of average daily spill amounts at the lower Snake River projects.

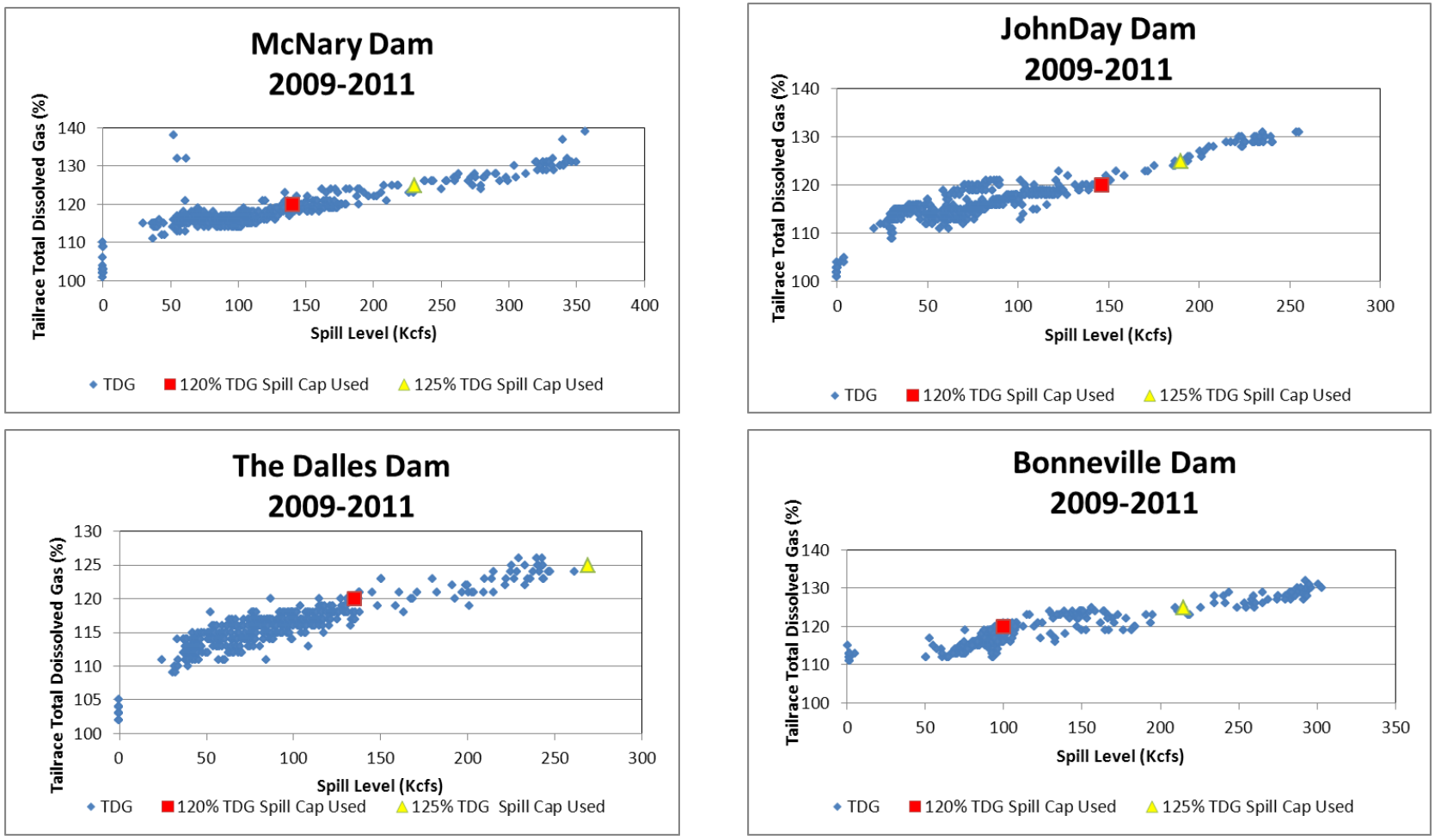

Figure 2. Tailrace total dissolved gas (average of the 12 highest hourly values in a 24-hour period) produced as a function of average daily spill amounts at the lower Columbia River projects.