FISH PASSAGE CENTER

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MEMORANDUM

TO: Rick Kruger, ODFW

FROM: Michele DeHart

DATE: April 25, 2011

RE: Lower Monumental SOR 2011-2

In response to your request, the FPC staff has reviewed the data relative to the Lower Monumental Dam uniform spill SOR 2011-2 , which has been discussed at the last several TMT meetings. The FPC reviewed data related to SARs, passage routes, bypass effects, and delayed mortality. SOR 2011-2 requests that the COE implement the uniform spill pattern when daily average flows at Lower Monumental Dam are expected to be at, or above, 100 Kcfs. Additional studies are planned to evaluate whether reducing the flow trigger to 80 or 90 Kcfs for this change is advisable. The implementation of the SOR would have allowed a higher volume of water to be spilled without exceeding the 120% total dissolved gas cap, enhancing fish passage through spill, while decreasing fish passage through bypass and turbine routes.

The Corps of Engineers rejected the System Operation Request 2011-2, stating that "the data do not compel the Action Agencies to make a change in spill pattern". Our conclusions, from our review of the available data, the 2009 Lower Monumental Study data and the operations data, follow and are contrary to the Action Agencies conclusion. The available data are compelling, and do support the agencies and tribes' recommendation for implementation of a uniform spill pattern at Lower Monumental.

- Performance standard testing, and dam specific fish passage operations are progressing forward on an ad-hoc basis without the development of a management decision framework in which all available data are considered in fish passage management decisions. The action agencies are not considering an increasing body of passage data that indicates that juvenile bypass system passage reduces smolt-to-adult return, and are not fully considering or are misinterpreting the 2009 Lower Monumental study.

- Implementation of the bulk spill pattern is not supported by the available data, including the 2009 Lower Monumental Radio Tag Study. The 2009 Lower Monumental Study indicates that juvenile fish passage is improved with the uniform spill pattern.
- The 2009 Lower Monumental Study was designed to test the performance standard measure for the bulk spill and the uniform spill separately. The study was not designed to **compare** bulk spill versus uniform spill. The study results indicate that only the largest differences in survival could have been detected between the two spill patterns. Because of low precision in the survival estimates, power analyses indicate that the survival estimates would need to differ by 5-6% in order to be detectable with 80% power.
- The uniform spill pattern can be implemented with higher levels of spill without violations of the 120% gas cap. Higher spill levels will reduce juvenile fish passage through the powerhouse therefore improving juvenile survival and SAR.
- There **are** compelling biological data that justify a change to the spill pattern as requested in the SOR. Improvement in important juvenile passage characteristics, such as shorter forebay delay, and decreased bypass passage under the uniform spill implementation were presented, but not considered by the COE in their application of the 2009 Lower Monumental Study results. The Action Agencies chose only **one** set of project specific radio tag studies to make their determination, and only one collected metric in that study. They chose to **ignore** several other studies that provide data to justify a change in the spill pattern as requested in the SOR 2011-2.
- SOR 2011-2 recommends the best possible operation for flows in the range of 100 Kcfs up to uncontrolled flow/spill levels (approximately 160 Kcfs) based on all available data.
- The effects of juvenile passage routes and the importance of spill, and the impacts of delayed mortality in survival to adult returns were not addressed or considered by the COE.
- The use of the radio tag studies exhibit parallel issues to those described by the FPC for the John Day acoustic tag studies (FPC memo dated February 16, 2011) used by the Action Agencies to chose a 30% spill level at John Day, rather than a 40% spill level. As with the John Day study, the Lower Monumental study results should be interpreted with considerable caution.

Background

The SOR 2011-2 was developed, and unanimously supported, by the Fishery Agencies and Tribes to address the conditions observed at Lower Monumental dam in 2011. Two continued unit outages at Lower Granite Dam resulted in large volumes of spill at this project, total dissolved gas in excess of the 120% gas waiver, and the passage of significant numbers of fish below the project. The spill at Little Goose and Lower Monumental dams was being restricted to address the high levels of total dissolved gas in the river, primarily related to the unit outages at Lower Granite Dam. It did not make sense to pass large numbers of fish in spill at Lower Granite, only to restrict spill passage downstream and force fish through bypass and turbine routes at Little Goose and Lower Monumental.

According to the FOP the spill operation at Little Goose Dam is restricted to 30% of instantaneous flow. At times the spill can be decreased to address TDG. However, more restricted is the operation at Lower Monumental Dam. Here the 2011 FOP calls for spill to the

gas cap. The COE establishes and re-establishes the levels of spill to the gas cap based on TDG readings at the Lower Monumental tailrace and the Ice Harbor forebay. The bulk spill pattern moves all spill to one area of the spillway and for a given volume and produces more TDG than uniform spill. So far this year (Apr. 3-24), the COE estimated spill caps have ranged from 25 Kcfs to 31 Kcfs. During the period when flows were manageable in 2010 (Apr. 3-June 2), the daily COE spill caps ranged from 13 Kcfs to 43 Kcfs. The TDG management problems associated with gas management at Lower Monumental Dam occur in every year, and are exacerbated by the use of the bulk spill pattern.

The spill pattern at Lower Monumental Dam has been discussed at both the FPOM and FFDRWG meeting groups. Originally, Fish Passage Plan change form 10LMN003 was submitted by Ann Setter of the COE on January, 11, 2010[1], the COE FPOM website lists this change form as pending[2]. All members of FPOM could not agree on the implementation of change form 10LMN003 and therefore the February 4, 2010 Final FPOM notes (Page 24) state that the record of final action for this change form was moved to the FFDRWG forum[3]. Several COE FFDRWG representatives have been contacted in attempt to obtain the notes of FDRWG LMN spill discussion. Currently, the FFDRWG notes have not been obtained; however, based on discussions with other fishery managers, it is believed that complete agreement between all members was also not achieved at the FFDRWG.

The bulk spill pattern was investigated because the uniform pattern at Lower Monumental Dam can create a large eddy when the power house is lightly loaded. This eddy increases the risk to both fish that passed over the spillway and fish that are discharged through the juvenile bypass pipe. However, under the conditions of a more fully loaded powerhouse (greater than 100 Kcfs, and possibly at lower flows between 80 and 100) the uniform pattern will not create a large eddy and will increase the number of fish being passed by way of the spillway by allowing higher spill volume.

Since the uniform pattern is not of concern at the flows discussed, the uniform spill pattern is preferred since it will allow for a lower total dissolved gas level for similar volumes than under the bulk spill, and will allow for higher volumes of spill to occur before meeting the 120% TDG criteria. On average, average daily flows at LMN during the 2009 study period (Apr. 28-May 24) were approximately 100.5 Kcfs. Under the two spill treatments, the COE estimated spill caps at Lower Monumental Dam under the bulk spill pattern ranged from 24-29 Kcfs, whereas that under the uniform spill pattern ranged from 26-38 Kcfs. Overall average spill percentages under the two spill treatments were 27% under the bulk pattern and 38% under the uniform pattern (Hockersmith et al., 2010). From this study, it is clear that the uniform pattern allows LMN to spill a higher volume (and, consequently a higher spill percent) while still maintaining compliance with total dissolved gas waivers.

[1] http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/2010/changes/10LMN003_Spill_Table_Consolidation_Pending.pdf.
[2] http://www.nwd-wc.usace.army.mil/tmt/documents/fpp/2010/changes/
[3] http://www.nwd-wc.usace.army.mil/tmt/documents/FPOM/2010/2010_FPOM_MEET/2010_FEB/.

A process for applying data and analytical results to fish passage management decisions has not been established

In our review of the John Day telemetry study FPC concluded "The evaluation of performance standards appears to be going forward on an *ad-hoc*, disjointed basis. There is no evidence of a disciplined framework for applying analytical results to management decisions. At the present time proposals to change operations based upon analytical results advance to discussion without adequate advance review and discussion of the underlying data and analyses. A management decision framework would allow information to be organized, with a clear understanding of its limitations, appropriate management applications, and would be presented relative to other available data. In addition, a management decisions framework would assure consistent technical and analytical approach to all project performance standards. In this way the management decision would incorporate all of the available data together, weighted by the limitations and appropriate application of each data set." Similar concerns can be applied in the case of Lower Monumental Dam passage and survival study results.

A management decision framework, in which all available data are considered, and the application of data and analyses to decisions regarding fish passage and spill management has not been identified. In this case a large body of data indicating that delayed mortality is associated with juvenile bypass passage has not been considered by the Action Agencies. The lack of a decision framework allows the misapplication, or partial application of available data and study results such as has occurred in the rejection of SOR 2011-2. The Action Agencies have decided against the uniform spill pattern on faulty basis including the mis-representation of the Lower Monumental 2009 Study as a **comparison** of bulk versus flat spill patterns. Decisions to modify or change fish passage operations should take into account ALL of the available data and the limitations of each data set. In this case the Action Agencies have attempted to apply the Lower Monumental Study results alone to the fish passage management decision without considering the limitations of the data and analyses. In a Decision Framework the limitations of the data from the 2009 study would be considered in the management application. Specifically the Lower Monumental Study design and results indicate that only the largest differences in survival could have been detected between the two spill patterns. Because of low precision in the survival estimates, power analyses indicate that the survival estimates would need to differ by 5-6% in order to be detectable with 80% power. Also, the comparison between uniform and bulk spill patterns is confounded by differences in the spill volumes (38% average spill during the uniform pattern versus 27% average spill during the bulk pattern). The lack of a Decision Framework for application of analytical results to management decisions has led the Action Actions to erroneously reject the Systems Operations Request.

Available data, including the Lower Monumental 2009 study, indicate that the uniform spill pattern provides improved juvenile fish passage

The COE conclusion that there is no compelling information to move to a uniform spill pattern is incorrect. They argue that survival is not significantly different for two different operations and therefore the two operations are equally protective of fish. . The 2009 Lower Monumental study showed significant differences in spillway passage efficiency for yearling Chinook. Under uniform spill, yearling Chinook passed in spill at significantly higher proportion 0.802 compared

to passage under bulk spill of 0.730. In addition, forebay delay was significantly shorter under uniform spill versus bulk spill. The study also showed that the bulk spill pattern significantly increased the proportion of yearling Chinook passing through the juvenile bypass system compared to the uniform spill pattern. Several independent groups of researchers (Buchanan et al. 2010, McMichael et al. 2010, Tuomikoski et al. 2010) have found fish passing through juvenile bypass systems have lower subsequent survival rates. Given these research results, the bulk spill pattern would be expected to reduce life-cycle survival rates compared to the uniform spill pattern because of the increased proportion of yearling Chinook that would experience the juvenile bypass system at Lower Monumental. These differences are compelling enough to suggest that uniform spill provides better protection for yearling Chinook than bulk spill. Direct measures of juvenile survival do not capture many of the benefits of increased spill passage efficiency.

In river migration conditions and the routes of passage at hydroelectric projects for juvenile salmonids have been shown to be important factors in determining the overall survival of fish to adulthood. Overall, the results in the 2010 CSS report indicate that the Northwest Power and Conservation Council SAR objective of 2%-6% SARs for federal ESA-listed Snake River and upper Columbia River salmon and steelhead is not being met for Snake River wild stocks of spring/summer Chinook and steelhead originating above Lower Granite Dam. Conditions that can affect SAR and first year ocean survival rates for Snake River wild spring/summer Chinook or wild steelhead populations include both ocean conditions and seaward migration conditions through the FCRPS (Schaller et al. 2007; Petrosky and Schaller 2010).

Among seaward migration conditions, *higher flows and controlled spill for fish passage increases juvenile survival and smolt-to-adult return rates* (CSS 2010 Annual Report). As in-river migration conditions have improved with decreased Water Travel Time (increased flow) and increased spill for fish passage, in-river survival has increased and TIR (Transport In River Ratio; see CSS 2010 Annual Report) has decreased. The TIR to reach survival relationship indicates that when in-river steelhead survival is above approximately 55%, transportation will be detrimental to full life-cycle survival.

Delayed mortality continues to be documented for spring/summer Chinook transported from the Snake River. New analyses indicate that *significant delayed mortality also occurs for steelhead and spring/summer Chinook passing through powerhouse juvenile bypass systems, resulting in reduced smolt-to-adult return rate*. Regardless of origin, reducing delayed mortality would correspondingly increase SARs. Bypass history was found to be an important factor for characterizing variation in post-BON SARs of yearling Chinook and steelhead (CSS 2010 Annual Report). The best-fitting model for yearling Chinook indicated that post-BON SARs were reduced by 10% per bypass experience at upriver dams. The best-fitting model for steelhead indicated a 6% reduction in post-BON SARs per bypass experience at Snake River dams and a 22% reduction in post-BON SARs per bypass experience at Columbia River dams.

Bypass passage routes have also been shown to be detrimental to survival to adult return in the COE funded Bypass Effects study. Bypass at Lower Monumental Dam appeared to be associated with reduced adult return rates for both spring Chinook and steelhead, with a slightly less obvious effect on summer Chinook. Spring Chinook salmon that were detected at Lower

Monumental produced from 2% to 36% fewer adults than expected on average, while summer Chinook detected at Lower Monumental produced an average of 2% to 28% fewer adults than expected from other inriver fish, depending on where else the smolts were detected downstream. Steelhead detected at Lower Monumental produced from 11% to 41% fewer adults than expected.

The 2009 Lower Monumental Study was designed to test the performance standard measure for the bulk spill and the uniform spill separately. The study was not designed to compare bulk spill versus uniform spill.

It is not clear what magnitude difference in survivals that the Lower Monumental study was designed to test. The study conclusions do not make recommendations regarding uniform versus bulk spill operations. In a previous FPC memo, similar comments were made regarding the John Day survival study when comparing survivals across spill percentages (FPC memorandum, "Review Performance Standard Testing/ John Day 2010", February 16, 2011, www.fpc.org). Caution should be used when attempting to answer comparative smolt survival questions across treatment levels without considering experimental design and statistical power. In particular the confidence interval around the 'Concrete' survival estimate for the bulk spill treatment on yearling Chinook is particularly wide. The standard error for this estimate is ~2.3% which falls outside precision criteria of the 2008 Biological Opinion for the Federal Columbia River Power System (FCRPS) and gives a confidence interval width of almost 9%. This indicates that the 2009 Lower Monumental Study was not designed to **compare** passage metrics between the bulk versus uniform spill pattern, and indicating that the COE reliance on this study to determine the fish passage operation is not supported by the data. There is no clear definition of the magnitude of difference in survival between treatments groups that this study was designed to detect. This raises serious unanswered concerns regarding the power of the Lower Monumental Study to compare survivals between uniform and bulk spill. Similar concerns were raised regarding acoustic tag studies of survival under varying spill operations at John Day Dam.

Literature Cited:

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DATA REQUEST FORM

Request Taken By: M. Filardo **Date:** 4/22/11

Data Requested By:
Name: Rick Kruger **Phone:**
Address: **Fax:**
Email: rick.kruger@state.or.us

Data Requested:
Evaluate information relative to uniform spill operation (attached) as in 2011-2, and as discussed at TMT

Data Format: **Hardcopy** ☐ **Text** ☐ **Excel** ☐

Delivery: **Mail** ☐ **Email** ☑ **Fax** ☐ **Phone** ☐

Comments:

Data Compiled By: FPC Staff **Date:** 4/25/11

Request # 38

Margaret Filardo

From: Rick Kruger [rick.kruger@state.or.us]
Sent: Monday, April 25, 2011 10:02 AM
To: Margaret Filardo
Subject: RE: Data Request

Margaret,

To further clarify, this formal request follows up on my verbal request from last Fri., for the the FPC to evaluate information relative to the uniform spill operation as outlined in SOR 2001-2 and as discussed at the TMT meetings. Could you please provide me with your evaluation by the end of the day today?

Thanks,

Rick Kruger

From: Rick Kruger
Sent: Fri 4/22/2011 1:36 PM
To: Margaret Filardo
Subject: Data Request

Margaret,

Could the FPC please assemble data supporting the the LMN uniform spill SOR, as has been discussed at the last several TMT meetings, and from various sources, such as the CSS? I am particularly interested in the broad range of data related to SARs, passage routes, bypass effects, delayed mortality, etc.

Thanks,

Rick