State, Federal and Tribal Fishery Agencies Joint Technical Staff

US Fish and Wildlife Service

Columbia River Inter-Tribal Fish Commission

Idaho Department of Fish and Game

Oregon Department of Fish and Wildlife

Washington Department of Fish and Wildlife

Shoshone-Bannock Tribe

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Dear Mr. Brown, Ms. Kalamaz, Ms. Fodrea and Mr. Peters:

The Bonneville Power Administration has developed and distributed a proposal to the Corps of Engineers Study Review Work Group (SWRG) to discontinue the 1% peak turbine efficiency turbine operating limits included in the NMFS Biological Opinion. We understand and support the ongoing process of evaluating hydrosystem operations and how they relate to fish survival. However, we find that the available evidence strongly suggests that operations outside the 1% of peak efficiency would be detrimental to fish. Therefore we cannot support the draft proposal submitted by BPA to discontinue operations within the 1% of peak efficiency in all mainstem federal projects. We support the implementation of the Biological Opinion (BiOp) measures requiring that turbines operate within 1% of their efficiency range.

State and tribal co-managers have reviewed the proposal and have summarized their comments and concerns below which are presented in detail in the following discussion. In addition we have attached our comments on a specific study proposal presented to the SRWG to study the 1% turbine efficiency operating criteria at McNary Dam in 2003.

- Our review of historic and recent data only finds evidence that supports maintaining the 1% peak efficiency limits included in the NOAA Biological Opinion.
- The BPA proposal shifts the burden of proof of risks to the fishery resource in favor of apparently more certain economic benefits for the hydropower system.
- The BPA proposal abandons the precautionary approach to hypothesis testing which is warranted in an endangered species context.
- The BPA proposal reflects a management priority, which is inconsistent with the fishery management priorities of the state, tribal and federal fishery managers submitting these comments. The BPA proposal to expend effort and limited funds to test fish survival relative to turbine efficiency ranges above levels that are safer for fish is establishing a federal operator priority for increasing hydropower revenue rather than fish protection. A priority established for fish protection would direct expenditures at keeping fish out of turbines and providing alternative passage routes rather than increasing passage of fish in turbines and operating turbines at levels that reduce fish survival. Expenditure of fish mitigation funds for this study is unacceptable to the natural resource managers.
- The BPA proposal does not address the deterioration of conditions in the gatewells and on the vertical barrier screens that will result from higher turbine flows. Gatewell and vertical barrier screen and orifice conditions will deteriorate and result in significantly increased fish injury, stress and mortality.

Our review of historic and recent data only finds evidence that supports maintaining the 1% peak efficiency limits for turbines included in the NOAA Fisheries Biological Opinion.

The NOAA Fisheries 2000 Biological Opinion (BiOp) includes the requirement that turbine operations be limited to within 1% of peak efficiency based upon evidence (both empirical data and expert opinion) suggesting that smolt survival was higher within these limits compared to operations beyond them. In an effort to re-evaluate this BiOp requirement, Bonneville Power Administration (BPA) has submitted a draft proposal (dated May 19, 2003) to discontinue these turbine operating limits. However, in our review of this proposal, historic data, and recent data, we only find evidence that supports maintaining the 1% of peak efficiency limits, and therefore do not support the BPA proposal on turbine operations. Our basis for this conclusion is outlined below.

<u>Milo Bell Compendiums</u>

Bell et al. (1967) and Bell et al. (1981) provided the first basis for the 1% of peak efficiency limits. These reports present published and unpublished data on survival of small fish passing through Kaplan- and Francis-type turbines. The Bell Compendiums provide compelling evidence that fish survival is generally higher when turbines are operated within the 1% limits than when they are operated beyond these limits. In addition, survival appears to decrease linearly as turbines are operated beyond peak efficiency.

These results make sense from a mechanistic perspective as well. Mechanistically, when turbines are operated beyond peak efficiency, flow fields in the turbines are disrupted, resulting in cavitation and damage to the metal surfaces in contact with the water. Clearly, this is an undesirable condition for fish, and therefore operations that create these conditions (i.e., operations beyond the 1% of peak efficiency limits) are expected to reduce survival. The data provided by the Bell Compendiums clearly support this expectation.

Eicher and Associates (1987)

In a comprehensive review of fish mortality through turbines, Eicher and Associates for EPRI (1987) reported the conclusions of a panel of experts that the maximum survival of fish coincides with the greatest turbine efficiency. Further they noted that turbine efficiency is determined by wicket gate openings and resulting flow qualities and design head in relationship to operation head, and that efficiency falls off after reaching a peak of 60-80% maximum flow into a unit. Eicher and Associates also note that the hydraulic character of the backroll of the turbine discharge into the tailrace is a function of overall flow into the turbine unit. They note as was described by NMFS in Bonneville Dam survival studies (Gilbreath et al. 1993) that the backroll carries fish into heavy predation zones. Eicher and Associates concluded by noting that diverting fish from turbines is probably the most cost-effective way of reducing fish mortality.

Skalski et al. (2002)

The data evaluated in Skalski et al. (2002) provide a second basis for maintaining the 1% efficiency limits. While their analysis was primarily focused on evaluating the academic question of whether peak survival coincides with peak efficiency, they do provide a useful summary of more recent data on the relevant operational question of maintaining the 1% of peak efficiency limits. Based on the data provided in Skalski et al. (2002, Table A.1), mean survival is reduced by 1.13% (for Columbia/Snake River projects) to 1.64% (for all projects) when Kaplan-type turbines are operated beyond the 1% of peak efficiency limits (Figures 1 and 2). In addition, survival decreases linearly as turbines are operated beyond peak efficiency for Columbia/Snake River projects (Figure 3).

Normandeau et al. (2003)

The presence of several study design flaws severely limits the utility of the 2002 McNary turbine survival study results summarized by Normandeau et al. (2003) for evaluating the BiOp turbine efficiency requirement. These flaws stem from both how the study was conducted and how the results can be interpreted given the greater context of fish passage at dams. We condense some of these issues into five main points, below.

First, operations beyond peak efficiency increase turbulence and flow within the gatewells, resulting in screen and orifice clogging, increased current velocities, and fish mortality along the intake and vertical barrier screens. During times of high debris loading, this problem is especially severe. Because fish were released within the gatewells in the 2002 McNary study, the survival estimates do not reflect this known problem. Furthermore, the estimates do not incorporate the changes in fish guidance efficiency that would occur with operations beyond the BiOp regulations.

Second, the sole use of large chinook salmon smolts prevents the application of study results to other species and size classes. As found in Skalski et al. (2002), turbine survival is significantly related to fish size, with smaller fish showing lower survival rates. Species that are more sensitive to turbine passage or are smaller than the large chinook smolts used in the 2002 McNary study will show reduced survival compared with results presented in Normandeau et al. (2003). Therefore using the 2002 McNary study results to overturn the BiOp turbine efficiency operating requirements, which in nature apply to all species and size classes, is inappropriate.

Third, spill operations and sample sizes were not consistent across the treatments in the 2002 McNary study. Treatments outside of the 1% limits (i.e., the 14 kcfs and 16.4 kcfs operations) had no spill during 6 of the 7 study days, whereas the treatments inside of the 1% limits had no spill for 4 of the 9 study days. This inconsistency in spill operations creates the question of whether the differences in survival estimates are the result of differences in turbine operations or of differences in spill. The number of fish released also differed among the treatments. Between 350 and 390 fish were released for 5 of the 6 treatments, but only 270 fish were released for the 14 kcfs treatment. The fact that this treatment also showed the highest survival is curious. Further, based on the results from previous studies, we expect survival to decline linearly as turbines are pushed beyond peak efficiency. Because the survival estimate at the 14 kcfs treatment is well above an interpolation between the 11.2 kcfs and 16.4 kcfs treatment estimates, this casts additional doubt upon the validity of the 14 kcfs survival estimate.

Fourth, we question the use of 48 h survival rates for evaluating delayed turbine mortality. Studies have shown that delayed mortality associated with turbine passage can be significant, and often is not manifested until several days following passage (Kostecki et al. 1987). Without holding the fish for longer periods, we cannot ensure that operations outside the BiOp limits will not jeopardize the long term survival of smolts. Further, forebay and tailrace mortality must be evaluated. Extended holding to assess delayed mortality presents other biases that make this approach difficult experimentally. These delayed and indirect effects may only be understood through studies that evaluate effects on smolt-to-adult survival rates.

Fifth, the efficiency levels chosen for the 2002 McNary study are not informative for comparing fish survival inside and outside of the 1% of peak efficiency operations. The 8 kcfs and 11.2 kcfs treatments lie at the boundary of the 1% limits and the other two treatments are beyond the limits. To evaluate whether operations outside the 1% limits do not negatively impact fish, data must be collected well inside of the 1% limits. Studies operating at the limits and beyond (e.g., the 2002 McNary study) do not provide information on the effects of turbine efficiency on survival because estimates are only collected at operations beyond the efficiency limits. Furthermore it is important to note the fact that Normandeau et al. (2003) report the planned discharges (8, 11.2, 14 and 16.4 kcfs) rather than the actual discharges (7.7, 12, 13.4, and 16.6 kcfs) throughout the document. This was misleading, as was the practice of claiming that the 11.2 kcfs treatment was near peak efficiency when in fact it was at the 1% boundary. We encourage proper and accurate documentation of study outcomes and request the authors of Normandeau et al. (2003) in the future refrain from reporting misleading and inaccurate treatment data and results.

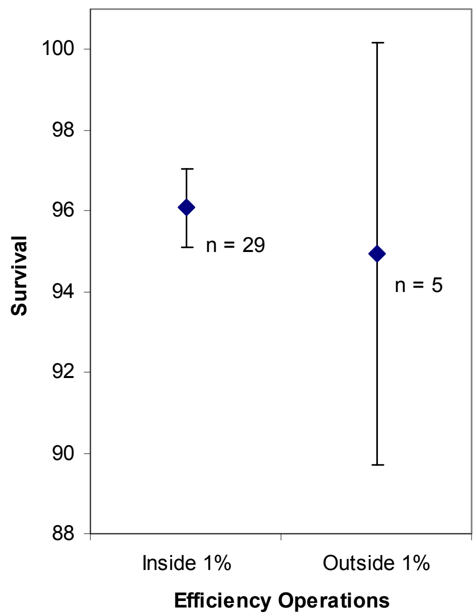

Figure 1. Mean survival and 95% confidence intervals for Kaplan-type turbines operated inside and outside of the 1% of peak efficiency bounds for Columbia/Snake River projects [Data from Skalski et al. (2002, Table A.1)].

Figure 2. Mean survival and 95% confidence intervals for Kaplan-type turbines operated inside and outside of the 1% of peak efficiency bounds for all projects [Data from Skalski et al. (2002, Table A.1)].

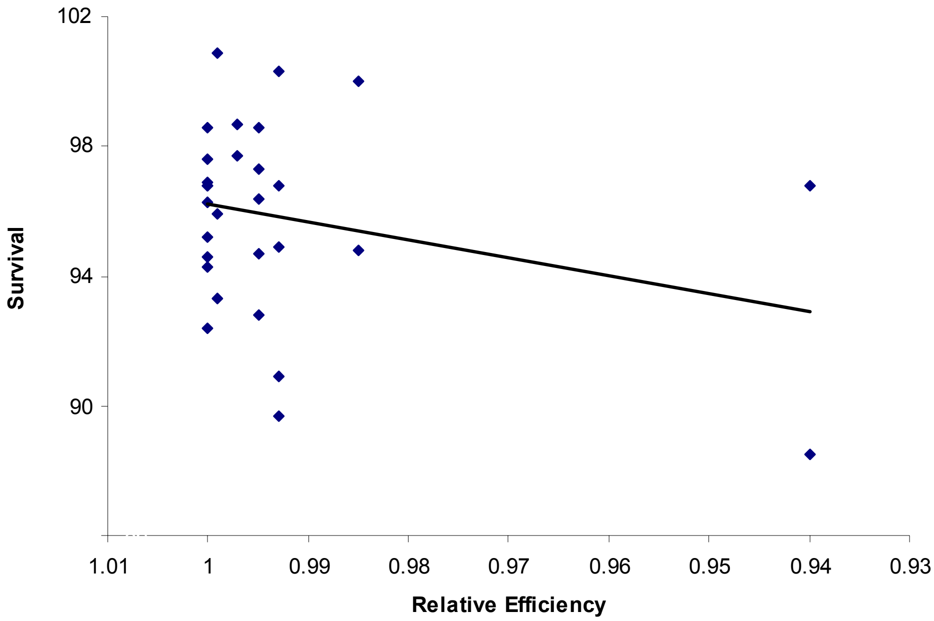

Figure 3. Relationship between survival and relative efficiency of Kaplan-type turbines for Columbia/Snake River projects [Data from Skalski et al. (2002, Table A.1)].

With respect to risks, the BPA proposal shifts the burden of proof to the fishery resource in favor of apparently more certain economic benefits for the hydropower system. The BPA proposal abandons the precautionary approach to hypothesis testing which is warranted in an endangered species context.

The BPA proposal is based upon BPA's decision to place the burden of proof for protection upon the ESA listed salmon, and other anadromous fish resources in favor of anticipated economic benefits to BPA.

The choice of a significance level determines the relative frequency of two kinds of mistakes, either rejecting the H_0 when it is correct making a Type I error, or failing to detect the truth of H_A when it is correct making a Type II error (Snedecor &Cochran, 1989) The failure rate β of not rejecting the null hypothesis when the alternative is "true" is termed the "Type II error" and the failure rate α of rejecting the null hypothesis when the null hypothesis is "true" is termed the "Type I error". In ecological studies, it is often desirable to balance these errors by applying the same failure rates to each type of error or even setting the failure rate such that $\beta < \alpha$.The proposal indicates that BPA is more willing to accept a Type II error than a Type I error. However, there are reasons why a more precautionary approach to hypothesis testing is warranted in endangered species contexts (Peterman 1990, Dayton 1998). Steidl and Thomas (2001) cite investigators who have suggested that Type II errors be considered paramount when monitoring endangered species; or at least that Type I and Type II errors be balanced based on their relative costs. In endangered species recovery activities, if a Type II error is committed, a population could be on its way to extinction before the decline is detected and preventative action is taken. Conversely, if the population is monitored after initiating recovery actions (such as implementing turbine efficiency limitations), and the population is actually increasing, a Type II error would lead to the mistaken inference that the actions are not having the desired effect, perhaps jeopardizing continuance of those actions. The limitations of empirical data and ability to determine small differences in survival should not result in placing listed stocks at additional risk. If the data and methods do not allow differentiation of small differences a precautionary approach to management of endangered species require adoption of the measures that provide conservation and protection of the species.

Proper consideration of the possible detrimental effects of failing to meet turbine efficiency requirements requires acknowledging the limitations inherent in the available empirical data on turbine efficiency and survival. It should be kept in mind, for instance, that it's difficult to accurately characterize exact turbine conditions experienced by individual release groups in the turbine survival studies. The most relevant question we can ask in light of these limitations of data is not whether we can tease out effects on highly variable survival estimates from small variations in turbine operations within a season. Many factors affecting turbine survival probability will always remain outside of management influence. A more relevant question is, over a longer time series, given a representative range of uncontrolled variation in factors affecting survival, are turbine operations within their efficiency ranges associated with higher survival rates?

The BPA proposal does not address the deterioration of conditions in the gatewells, on the vertical barrier screens, and in the tailrace which would result from higher turbine flows. Gatewell and vertical barrier screen conditions would deteriorate and result in fish injury, stress, and direct and delayed mortality.

During 1997 and 1998 studies were conducted (Brege et al. 1998, Brege et al. 2001) to evaluate the vertical barrier screens and outlet flow control devices at McNary Dam. In those studies turbines in the test units were operated at low load 60 MW and high load 80 and 75 MW. Those tests with spring migrants showed that there was significantly higher levels of descaling under high turbine load operations. Under high load conditions descaling averaged 17 % versus 6.7% at low loads.

Present studies indicate that delayed mortality is an important factor in return of adult transported salmon and steelhead. Smolt to adult return data (CSS status report 2001) indicates that smolt to adult return rates for bypassed smolts are lower than spill passage. The BPA proposal to operate turbines at higher loads, given the results of gatewell vertical barrier screen descaling data, will potentially exacerbate and add to delayed morality for transported smolts and reduced survival of bypassed smolts.

The current proposal outlines BPA's justification for operating turbines, specifically at McNary Dam, outside the current 1% efficiency guidelines. The 1% operation was implemented based upon previous research that showed a relationship between peak efficiency of the turbine and maximum survival. BPA has outlined their rationale for believing that this data may not be accurate. Regardless of the debate over operating ranges and juvenile survival through the turbines, operating the turbines outside of 1% percent to increase generation will divert more flow through the turbines. This will likely increase the number of juveniles using this route of passage. As flow through a route increases so does the number of juveniles that use the specific route. This has been shown through countless passage evaluations. Thus, more juveniles will pass via the turbines; only the percent increase is uncertain. Current estimates for passage through the turbines are 86% and 87% from the radio tagged fish evaluation in the 2002 survival study conducted at McNary dam to test the 11.2 and 16.4 kcfs flow rates through the turbines. The project goal is to attain project survival in the high to upper 90's, ideally a route specific survival would be 98%. By increasing the number of juveniles using the turbines, project survival is going in the wrong direction, making it more difficult to attain the goals set out in the 2000 BiOp.

While gatewell releases during the April 2002 evaluation showed no difference in fish condition or survival, the gatewells were clean and operating at an ideal condition. During this time of year, there is little debris and no temperature problems; hence, this evaluation did not test a worst-case situation. By increasing flow through the turbines, more flow will be directed up the gatewell. Peak debris loads normally occur during the spring freshets and during the late summer. As debris and grasses are guided up into the gatewells with the migrating fish, increased head differentials across the barrier screens become evident and normally fish quality/condition problems start to manifest itself at the project. Not only is this hard on the screen mesh and other associated equipment in the gatewells, but fish that are guided into the slots can be injured or worse yet killed as hot spots (increased velocities) along the screen mesh develop. In past years and at present, to best counteract this problem, the project biologists would advise the project to reduce turbine loading to minimum operating levels and where warranted the unit would be taken down and the barrier screens cleaned. Increasing megawatts at McNary for example would only exasperate a "known" condition that currently exists at the project and is counter to improved fish survival goals stated in the 2002 BiOp.

Furthermore, the 2002 spring evaluation measured a much reduced residence time for fish released into the gatewell at 16.4 kcfs. Reductions in gatewell residence have been noted in the past when gatewell conditions become more turbulent and more aggressive hydraulically, which make it more difficult for juveniles to avoid the orifices. Under these condtions the juveniles are more similar to buoyant particles than active swimmers. This situation can be very injurious to fish, even under medium debris loads. This would also likely lead to reduced survival for fish using the bypass system, which would again drive project survival in the opposite direction of the survival goals for McNary as outlined in the 2002 BiOp.

The BPA proposal states that the SIMPASS model showed no difference in project survival. Notably the evaluation is missing the summer component. The evaluation used in the proposal used spring conditions. However the current operation under region discussion will continue through the summer. Current operations at McNary involve daytime involuntary spill. By increasing turbine flow, more fish will be passed via the powerhouse and turbine units as daytime involuntary spill is reduced. Because of the limited powerhouse capacity at McNary, involuntary spill was included in the biological effects analysis during the ESA consultation in 2000. By reducing the involuntary spill, project survival will be decreased and once again the separation between current conditions and the survival targets in the BiOp will be increased.

Table 3 in the BPA proposal, on page 27 describes the SIMPASS assumptions, has questionable values for turbine survival. BPA used balloon tag survival estimates for turbine survival. Balloon tag survival is not an appropriate technique to get a route specific survival due to the interaction of the tag and test animal. Balloon tags only estimate direct survival at best, and do not look at indirect survival post passage. Balloon tags are commonly used to identify areas of concern for passage, not to estimate route specific survival. A radio tag survival study was conducted along with the balloon tag study in 2002. Estimates for survival between the two turbine levels where 86% versus 87% as opposed to the 95% and 93% survival used by BPA in the SIMPASS model. Furthermore, BPA did not model any changes in FGE or FPE as more flow was passed by the turbines, which is questionable when doing a sensitivity analysis for turbine and project survival.

We understand that Bonneville Power Administration's objective is to enhance hydropower production without reducing fish survival. However, the proposal eliminate the 1% turbine efficiency operating criteria included in the NOAA Biological Opinion does not accomplish that objective.

BPAs proposal for operations and study does not represent a prudent expenditure of funds or assignment of priorities from a fish protection standpoint or a Biological Opinion progress check in dates. The BPA proposal is counter to BPA's historical position that turbines should run at peak efficiency during fish migration season. The primary objective of the BPA proposal is to increase hydrosystem revenue.

However, running turbine units outside of 1% peak efficiency will cause cavitation and poor operational conditions that would require more frequent shutdowns of units to repair cavitation damage (Shelton and Loupin 1995). In Europe, turbine units are never operated outside peak efficiency criteria because the costs of shutdowns and repairs are prohibitive. Increased repair costs and unit shutdowns for repairs may actually reduce overall FCRPS hydro revenues, or simply shift anticipated revenue gains to BPA with repairs costs to the Corps.

Precautionary management as anticipated by ESA would place the highest priority on increasing fish survival at the projects which would place the highest priority for expenditure of funds on actions that would reduce injury through the bypass, reduce fish passage through the turbines and provide alternatives to turbine passage. Fish survival is lowest through turbines than any other passage route even within the most efficient turbine operating range, , the BPA proposal will increase the proportion of fish passing through the most lethal project route.

Study design
Studies conducted to date have not shown that survival is improved or unchanged under high load turbine operations. The precision of the balloon tag studies does not support a management decision to eliminate the turbine efficiency requirements of the NMFS Biological Opinion. Please refer to our specific comments (attached) on the BPA,COE proposal to study the 1% turbine efficiency criteria at McNary Dam in 2003.

Conclusions

- Historical and present data does not support the BPA proposal to eliminate turbine efficiency requirements of the BIOP.
- The BPA proposal inappropriately shifts the burden of proof to the fishery resource, placing a higher level of risk on listed and non-listed fish stocks.
- The BPA proposal if implemented is likely to exacerbate issues of delayed mortality on transported fish, and reduced survival of bypassed fish and turbine passed fish due to increased stress, injury and descaling in the gatewells and degraded tailrace conditions.
- Studies of survival relative to turbine operations are turbine operations are a low funding priority in comparison to funding alternatives to turbine passage.
- Funds intended for current fish mitigation programs should not be expended on these proposed studies.
- A proposal to increase fish passage through turbines is counter to the aggressive, non-breach all-H recovery plan that BPA to this point has supported.

Sincerely,

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Ron Boyce, ODFW

Tom Lorz, CRITFC

Keith Kutchins, SBT

Shane Scott, WDFW

Bob Heinith, CRITFC