SYSTEM OPERATIONAL REQUEST: #2003-MT-1

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DATE: July 1, 2003

SUBJECT: **Libby & Hungry Horse Operations for July through September and modified spill in the Lower Columbia River**

Biological Objectives

The objective of this SOR is to implement a staged multiyear experiment to evaluate the effects of more stable flows out of Libby and Hungry Horse during July, August and September and to reduce the overall draft of the storage reservoirs above these dams. The proposed operation will provide habitat that is proposed for "critical habitat" designation by the USF&WS for listed bull trout. The proposed operation in this SOR will also provide improved environmental conditions for other resident fish that inhabit the reservoirs and the rivers below the dams. In addition, the use of spills in the Lower Columbia during the summer months of July and August is modified to optimize dam passage when the majority of in-river fish are migrating passed the dams. These objectives are consistent with implementation of the Council's recommendations for Mainstem operations.

This SOR proposes to implement, in Phase I, an evaluation of the physical effects caused by the proposed operational changes at Libby, Hungry Horse and in the Lower Columbia River. During Phase I, the primary objective will be to test and evaluate the physical changes in flows and water quality that occur in reservoirs and rivers in Montana and the Lower Columbia River below McNary. During next year it is proposed that Phase II begin with additional physical testing and evaluation combined with biological experiments designed to evaluate the changes in survival of anadromous fish in the Lower Columbia due to the proposed changes in flows and spills. There will also be additional experiments designed and implemented in Montana to better evaluate the biological benefits seen from the proposed more stable flows and reduced reservoir drawdowns. During Phase III it is proposed that additional biological experiments be designed and conducted to develop a better understanding of those factors that are most important to lifecycle survival for both anadromous and resident fish. If adverse biological effects are observed as these large scale experiments are implemented, operational changes maybe necessary. If this occurs any proposed changes in this SOR will be reviewed and approved by TMT.

Specifications

During Phase I implementation will focus on physical evaluation of the changes in water qualities and quantities that result from large scale testing of the Northwest Power Planning Council's Mainstem Recommendations for operation of Libby and Hungry Horse dams and from reduced bypass spills during July and August at Bonneville, The Dalles and John Day dams.

- During July, adjust Libby outflows until refill has been achieved while avoiding significant risk of filling and spilling or in failing to fill to less than 5 feet of full.
- Adjust Libby's target outflow as necessary to maintain a stable weekly average outflow that results in drafting Libby to elevation 2449 by the end of September. It is preferred that outflows are held flat or are reduced gradually from July through September.
- Establish a weekly average outflow target of 3.7 kcfs at Hungry Horse dam.
- Adjust the target outflow as necessary to maintain a stable weekly average outflow and draft Hungry Horse to elevation 3550 by the end of September. It is preferred that outflows are held flat or are reduced gradually from July through September.
- Maintain flows out of Libby and Hungry Horse that are at least the minimum flows for bull trout. Minimum bull trout flows are a higher priority than the ending elevations targeted for the storage reservoirs by the end of September.
- Continue to implement bull trout research to measure changes in fish survival and productivity.
- Reduce summer bypass spills at Bonneville dam to a daily average of 50kcfs, ending on August 15th.
- Reduce summer bypass spills at The Dalles dam to 30 percent of river flow, ending on August 15th.
- Conduct the current spill test at John Day dam and eliminate bypass spills once the test is concluded. This is planned to occur at the end of July.

Phase I Experiments

Phase I testing will implement the following aspects of possible physical changes to the reservoir and river system.

Water velocity measurements in Lower Columbia River

As flows change, 5 to 10 key cross-sections will be chosen by the Corps and reviewed in the regional forum process. At each of these cross-sections the water velocity will be measured. This will show the actual changes in velocity as flows change across the full cross-sectional profile.

Water Travel Time and Routing Evaluation

The travel time for water drafted from Montana reservoirs down to the Lower River needs to be better measured and understood. This aspect of the Phase I physical testing will determine when Montana water actually gets to the lower river. This will allow the determination of what anadromous fish would be exposed to the effects of flows from Montana and determine what amount of water is captured in storage reservoirs downstream of Montana. This will provide an estimate of how protracted any flow augmentation from Montana reservoirs becomes as it gets to the Lower River.

Evaluate Grand Coulee water retention times

Use the existing models or other methodologies to determine the change in water retention times associated with Montana water releases. This will help to formulate a water retention time base line against which operational changes can be evaluated.

Temperature & Dissolved Gas Monitoring

Conduct a systematic evaluation of changes in water temperatures in the Lower Columbia. Attempt to determine the extent to which flow changes from Montana reservoirs affect temperature measurements in the lower Columbia River. Monitor changes in gas levels and plume sizes associated with reduced spill.

Biological Evaluations in Phase I

Repeat recent radio tracking experiments in the Flathead and Kootenai. This will allow the comparison of change in fish movement and response to flow changes during the recent relatively high flow years with the modified operation called for in this SOR.

Review the IFIM data and modeling under both the previous operation and under the proposed operation. Actual field observations will be conducted to see how fish are using the habitats at more constant flows and determine any changes from previous measurements.

Evaluate the changed operations by using the existing biological models and validate these simulations with field sampling to determine the change in primary productivity and insect production in the reservoirs. Also evaluate the in-river changes through food web sampling and compare with baseline data.

In the Lower River existing radio tracking experiments should be continued and combined with pit tag data that will help to compare fish (adult and juvenile) travel times across the range of flows. Evaluate the rate of adult fall back and compare this year with previous years.

Montana Fish Wildlife and Parks has a range of field experiments underway that can provide useful information on the changes in survival and productivity of bull trout and resident fish below Libby and Horse and in the reservoirs. These experiments will be continued and to the extent possible provide additional biological information on the benefits of the proposed operation for resident fish.

Justification

Libby & Hungry Horse Operations

The biological justification for the recommended reservoir operations in this SOR are based on quantitative biological modeling of Hungry Horse and Libby Reservoirs (Chisholm et al. 1989; May et al. 1988; Cavigli et al. 1998; Dalbey et al 1997; Zubik and Fraley 1987; Skaar et al 1996). Computer models were constructed using empirical field measurements of physical and biological parameters, as related to dam operations (Marotz et al. 1996). Conditions in the reservoirs resulting from various dam operation scenarios were assessed beginning with the hydrologic mass balance and thermal structure in the reservoir pool. The models calculate the biological response extending from primary producers (plants) through tertiary trophic levels (fish growth). Fish growth is correlated with survival, fecundity and reproductive success (Chapman and Bjornn 1969).

Nearly all biological production in the reservoir pool occurs during the warm months (Chisholm et al. 1989; May et al. 1988; Marotz et al. 1996). Failure to refill the reservoir each summer impacts reservoir productivity. At full pool, the reservoir presents a large volume and surface area. The sunlit surface layer of the reservoirs produces food (*zooplankton*, a microscopic crustacean that grazes on suspended algae called *phytoplankton*) that forms the base of the food web. The large flooded area produces aquatic insects and the large surface area traps insects from the surrounding landscape. Insects provide the primary food source for westslope cutthroat trout and juvenile bull trout during summer and fall (May et al. 1988). Biological production generally increases with reservoir elevation. Reducing reservoir drawdown (duration and frequency), especially during summer, protects aquatic insect production in remaining wet portions of the reservoirs, assuring an ample food supply for fish. During winter, fish (kokanee, westslope cutthroat and rainbow trout, whitefish, chubs, and suckers) eat mainly *zooplankton*, a microscopic crustacean that grazes on *phytoplankton,* suspended algae.

Riverine biology in Montana is based on field sampling (Fraley and Graham 1982) and quantitative computer models that were designed using a modified form of the Instream Flow Incremental Methodology (IFIM). River models quantify the total availability of various habitats for selected life stages of native fishes (i.e. bull trout and westslope cutthroat trout) under different dam operation scenarios. The IFIM models were developed based on site-specific habitat suitability data collected from the Flathead and Kootenai Rivers downstream of the dams. IFIM studies have provided empirical evidence for seasonal flow limitations and ramping rates (Hoffman et al. 2002; Marotz and Muhlfeld 2000; Muhlfeld et al. 2003).

River fisheries benefit when dams are operated consistent with normative hydrologic conditions (Muhlfeld et al. 2003; Paragamian 2000; Independent Scientific Group 1999; ISAB 1997 and 1997b; Hauer and Potter 1986). Normative hydrologic conditions mimic natural processes and minimize impacts on fish and wildlife (Ward and Stanford 1979). For example, Muhlfeld et al. (2003) found that subadult bull trout moved from deep, midchannel areas during the day, to shallow low-velocity areas along the channel margins without overhead cover at night in the partially regulated reaches of the Flathead River. The authors recommended restoration of the most natural and stable flow regime possible to protect key ecosystem processes and maintain or restore bull trout populations in the Flathead and elsewhere in the Pacific Northwest (Independent Scientific Group 1999). Conversely, fluctuating stream flows resulting from dam operation directly affect the aquatic environment and associated riparian and wetland habitats downstream of headwater reservoirs. Flow fluctuation increases the width of the varial zone that becomes biologically unproductive (Perry et al 1986; Hauer et al. 1997; Hauer et al. 1974). Normalized river flows benefit all fish species of special concern in Montana. Especially during the productive warm summer months, river flows should gradually decline toward stable summer flows to protect biological production in the rivers downstream of the dams.

The biological objective of drafting Libby and Hungry Horse reservoirs during the summer for anadromous fish is based in a belief that increased flows in the Lower Columbia will provide biological survival benefits for listed Snake River fall chinook. This belief was challenged by the ISAB in a recent report to the Council on the scientific justification for augmenting flows using limited reservoir storage volumes. The ISAB said:

> "The prevailing flow-augmentation paradigm, which asserts that in-river smolt survival will be proportionally enhanced by any amount of added water, is no longer supportable. It does not agree with information now available."

However, many arguments are also made that travel time is also a critical attribute of overall salmon survivals. With respect to the travel time argument the ISAB said:

> "The paradigm that faster movement of smolts to the estuary and ocean is always favorable for survival needs to be evaluated. Most of the reach survival studies we reviewed make this assumption. Increased migration rate and survival in the studied reaches (primarily the lower Snake River) does not ensure survival in lower reaches. The fish have to spend their time somewhere and could experience increased survival rates, the same survival rates, or decreased survival rates."

The ISAB also reviewed the latest in scientific research into the affects of flows on survivals of anadromous fish in the Mid-Columbia and Lower Columbia reaches where it found:

> "Flow appears to be the most influential factor affecting migration speed of steelhead and sockeye; for yearling chinook no effect of flow on migration speed has been found (only level of smoltification affected migration speed); for subyearling chinook no environmental variable was found to affect migration speed in the mid-Columbia. Since 1998, PIT tag and radiotelemetry studies have produced limited data on the survival of yearling chinook. Data on other species is even more limited. The studies-to-date do not indicate any statistically significant effect of flow on survival of juvenile salmonids in the mid-Columbia Reach, other than in the Hanford Reach, where stable flows are the issue. Limited data are available for lower Columbia Reach. Low flows are likely to lead to residualization of steelhead."

The ISAB also reviewed the status of research into the impact on resident fish of reservoir operations that have been dominated by attempting to meet summer flow objectives at McNary. With respect to the impact on resident fish in Montana the ISAB said:

> "It is a well- established fact that storage reservoir drawdowns result in adverse effects on resident fish populations and their associated fisheries. In earlier reports we recommended that an effort be made to balance the needs of resident fishes upstream against those of juvenile salmon downstream. We identified the Rule Curves developed in Montana as being reasonable approaches to resolving difficult policy issues with biological implications. The subject of tradeoffs of benefits to salmon versus detriments to resident fishes is one of the subjects deserving high priority action by the Council."

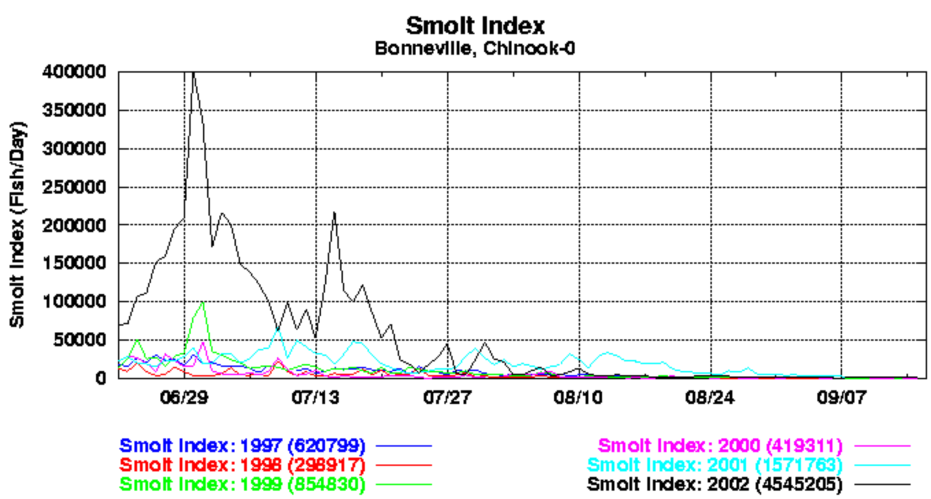
While there is little information on the survival of Snake River fall chinook in the Lower Columbia it is known that only a small percentage of the population actually migrates through the lower river due to the transportation program. The vast majority of listed Snake River fall chinook is transported and these fish cannot benefit from flow augmentation or spill. The majority of transported fish survive to below Bonneville while the fish that are left to migrate through the Lower Columbia experience high mortality rates due to a host of factors including higher dam passage, water temperatures and high predation rates.

The recommended changes to operation of Libby and Hungry Horse reservoirs cannot affect the survival of fall chinook that are barged to below Bonneville dam. For this reason the benefits of flow augmentation in the lower river will be very difficult to measure through scientifically valid experiments. Scientific experiments are further complicated by the increasing water temperatures that make it virtually impossible to handle and mark fish during August without creating unacceptable levels of direct mortality. For all these reasons, Montana recommends that operation of Libby and Hungry Horse dams be changed this summer and that biological survival experiments be designed and implemented in the lower river next year.

The proposed operation for Libby also has potential biological benefits for this year's unique sturgeon spawning. This year, sturgeon were moved to better substrates and eggs were detected. This makes it particularly important that flows be optimized in the Kootenai to assure the highest probability of survival. This year is the first known spawning event over suitable substrates for Kootenai River white sturgeon since sampling began in early 90's and it is the first chance at achieving natural recruitment since 1974. This SOR recommends that the white sturgeon recovery team be tasked with creating a monitoring program for these sturgeon based on the more stable river flows proposed.

Summer Bypass Spill

Also because nearly all of the fall chinook that survive to below Bonneville dam are transported, there is very little affect on survivals of listed Snake River fall chinook from spilling water at John Day, The Dalles and Bonneville dams during the summer months of July and August. The normal migratory pattern for fall chinook, shown in the following graph, also provides for most of the out migration to be accomplished during the months of June and July. The figure shows the smolt index counts for Bonneville dam during the last six years and it shows that by late July the majority of the run has passed.



The current bypass spill operation calls for significant spills during the month of August. This is particularly ineffective for Snake River fall chinook because, again, most of them are transported. The survivals of both Hanford Reach and Snake River fish were evaluated by NOAA using the SIMPAS model in June 2001. In this study it was shown that summer bypass spill could be substantially reduced with little impact on the survival of Hanford Reach fall chinook and negligible impact on survival of Snake River fall chinook. The study looked at a number of alternative spill levels. At what was called the 400 MW-month level of spill it was assumed that Bonneville would spill at 50 kcfs for 24 hours for the month of July and that The Dalles would spill at 40 percent of river flow for 24 hours also during July. There would be no spills at John Day.

This study reported the change in survival for **in-river** Snake River fall chinook to be 0.25 percent from the head of Lower Granite reservoir to below Bonneville dam. The study also looked at the change in "total system survival" by including the Snake River fall chinook that are transported to below Bonneville. The total system survival by changing to 400 MW-months of spill was estimated to be 0.01 percent lower than the estimate system survival for the full Biop amounts. These results are negligible changes in survivals that are will below the level of resolution possible from models like SIMPAS.

This same NOAA study reported that the survival of Hanford Reach fall chinook would change by 1.3 percent from McNary to below Bonneville if spills were reduced from the full Biop amounts to 400 MW-months. This too is a very small change in survival.

Montana recommends that summer bypass spill be used to enhance its biological benefits by focusing its application when there are large numbers of fish in the river and at those dams where it is of the greatest biological benefit. This occurs at Bonneville and The Dalles dams during July and the first portion of August. There currently is a spill survival experiment planned for John Day during July. For this reason, this SOR recommends that this experiment be conducted but that summer bypass spills at John Day be terminated at the end of the experiment. This will result in additional spill over the volumes assumed in the NOAA study and a power loss of more than 400 MW-months. The increase in spills over those modeled by NOAA is not likely to produce substantial changes in the survival estimates.

The net affect of the recommended changes are to more effectively and efficiently utilize the resources available in Montana reservoirs and to focus the use of summer bypass spill at those locations and at those times when it will be most beneficial for listed Snake River fall chinook.

Modeled Scenarios for Libby and Horse Operations

As requested by Montana at the last TMT meeting, the Corps has evaluated several alternative operations for Libby dam based on runoff forecasts and reservoir conditions. Three alternative scenarios were evaluated.

1. Implementing the recommended operation in this SOR at Libby.
2. Draft Libby 10 feet from full by the end of August.
3. Currently planned draft of 20 feet by the end of August.

The Corps will provide the results of their analysis at TMT, but a preliminary study showed that under the recommended operation an average flow of 10 kcfs can be maintained out of Libby from refill until the end of September. This will provide near optimum habitat and flow conditions for bull trout both in the river and the reservoir.

If the reservoir is drafted the full 20 feet by the end of August it will result in what has been called the "double peak" in flows because a very high outflow of approximately 17.5 kcfs is required to evacuate the full 20 feet in such a short period of time. Flows then fall rapidly in September. This reservoir operation exacerbates biological impacts on bull trout and other resident fish due to the large flow fluctuations and the large drawdown of the reservoirs.

Northwest Power Planning Council Recommendations for Libby & Hungry Horse Operations

The Council's recommendations for Libby and Hungry Horse operations are:

1) Reduce the frequency of refill failure (to within five feet of full pool) as compared to historic operations; implement seasonal flow windows and flow ramping rates in the Flathead and Kootenai rivers downstream of the storage reservoirs and maintain minimum flows in the Flathead and Kootenai rivers as described by the U.S. Fish and Wildlife Service 2000 Biological Opinion and the Montana Department of Fish, Wildlife and Parks.

2) As an experiment, implement and evaluate an interim summer operation as follows:
   - Summer reservoir drafting limits at Hungry Horse and Libby should be 10 feet from full pool by the end of September (elevations 3550 and 2449, respectively) in all years except the lowest 20th percentile water supply (drought years) when the draft could be increased to 20 feet from full pool by the end of September. This would protect fisheries resources in the reservoirs and rivers downstream, while providing additional flow augmentation for fish immediately below the project(s) and in the lower Columbia River.

   - Draft each storage reservoir according to elevation limitations that, when combined with projected inflows, result in stable and "flat" or very gradually declining weekly average outflows from July through September. The Council understands that the effect of these operations and summer drafting limits would be to reduce the drafting of these two reservoirs in summer compared to what they would be under ordinary biological opinion operations. The Council believes there is significant flexibility within the biological opinions to implement this operation as an experiment. If there is disagreement on this, the Council calls on the federal operating agencies and federal fish and wildlife agencies to consult on the operation of these two projects in an effort to reach agreement that will allow this operation as an experiment. The agencies should also continue to investigate creative water management actions for summer flows, including what are known as the "Libby-Arrow" and "Libby-Duncan" swaps, although implementation of the summer operations experiment at Hungry Horse and Libby is not to be dependent on these actions.

- Little information exists about the relationship, if any, between levels of flow, flow augmentation and juvenile and adult salmon survival through the lower Columbia hydrosystem reach. Therefore, the focus of the experiment and evaluation to accompany the implementation of these summer operations at Hungry Horse and Libby should be on a) ascertaining the nature, extent of and reasons for a flow-survival relationship through the lower Columbia system, if any exists; b) determining whether flow augmentation from the upper Columbia storage projects has any effect on levels of survival; and c) determining the benefits to resident fish from this operation. The Corps of Engineers and the Bureau of Reclamation should consult with a team formed from the Council, the Independent Scientific Advisory Board, the Montana Department of Fish, Wildlife and Parks, the Confederated Salish-Kootenai Tribes, NOAA Fisheries and the U.S. Fish and Wildlife Service to design a proper experiment and evaluation of this nature to take place during the implementation of these operations. The Council's hypothesis is that the proposed operations will significantly benefit listed and non-listed resident fish in the reservoirs and in the portions of the rivers below the reservoirs without discernible effects on the survival of juvenile and adult anadromous fish when compared to ordinary operations under the biological opinions.

- As the federal operating agencies implement this operation, they should ensure there is no adverse biological impact on Lake Roosevelt fisheries due to changes in reservoir elevations or water retention times. The operating agencies should report annually to the Council on the nature and extent of impacts to Lake Roosevelt from this summer operation at Hungry Horse and Libby. The Council will analyze this information, and if the Council decides the impacts to Lake Roosevelt fisheries are unacceptably adverse, the Council will make additional recommendations on operations to the federal operating agencies.

The Council's recommended changes in summer operations for Libby and Hungry Horse were to be implemented as "large scale field tests" because without making a substantial change it would be impossible to measure biological benefits or impacts. The Council recognized this when it said in its Mainstem Rule, "

> "It should be emphasized that this approach represents more than passive observation. It includes the option of implementing large-scale field tests

of hypotheses that will sometimes require changes in hydrosystem operations. In some cases, there may be risks associated with conducting the experiment, but these risks must be weighed against the risks of continuing operations without accurate information and against the potential risks to other fish species."