APPENDIX E

SECTION III. OF THE NMFS 1998 SUPPLEMENT TO THE BIOLOGICAL OPINION ON FCRPS OPERATION SYSTEM SPILL

Operation of the Federal Columbia River Power System Including the Smolt monitoring Program and the Juvenile Fish Transportation Program: A Supplement to the Biological Opinion Signed on March 2, 1995 for the Same Projects

May 14, 1998

Excerpt from Section III. Proposed Action:

3. System Spill

The Action Agencies had proposed in their Biological Assessment to modify spill levels from those specified in 1995 RPA Measure 2. The NMFS undertook a comprehensive review of the new information regarding the effects of spill (Appendix C) including revised project-specific estimates of:

- Estimates of fish guidance efficiency (the proportion of juveniles approaching turbine intakes which are guided into bypasses);
- Total dissolved gas levels associated with spill levels at each project; and
- New spill efficiency estimates for some projects (i.e., the proportion of fish approaching a project that pass via the spillway, divided by the proportion of total flow that is spilled).

The 1995 RPA defined an 80% fish passage efficiency goal for spill but recognized that some projects would achieve a lower fish passage efficiency due to dissolved gas limits (1995 RPA Measure 2). The NMFS review indicated that, while some projects were meeting the 80% fish passage efficiency goal (i.e., proportion of fish passing by non-turbine routes), others were not. Although the levels of spill provided during 1995 through 1997 were consistent with the spill recommended in the 1995 RPA, NMFS supports additional spill on a system wide basis to provide further benefits to steelhead while also increasing the survival of Snake River spring/summer and fall chinook and sockeye. The additional spill should be provided as described below pending review of performance (i.e., spill effectiveness and efficiency) and consideration of biologically-based performance standards for project passage. The Action Agencies anticipate development of such a standard by the end of 1999 and have agreed to provide this additional spill during the interim period. To the extent that FPE at some projects will exceed 80%, this additional spill supplements 1995 RPA Measure 2 for the interim period pending decisions on long-term actions.

The Action Agencies proposed that the actual dates of spill and flow augmentation be determined annually by the TMT based on inseason monitoring information. However, the planning dates are April 3 (modified from the April 10 planning date specified in 1995 RPA Measure 2) to June 20 and June 21 to August 31 for spring and summer, respectively, in the Snake River; April 10 to June 30 in the mid-Columbia River; and April 20[1] to June 30 and July 1 to August 31 for spring and summer, respectively, in the lower Columbia River. Initial estimates of spill levels, and the basis for each estimate, are shown below (Table III-2). The specific spill volumes listed in Table III-2 must be viewed as approximate because the total dissolved gas levels measured at the monitoring site below each project, at a given spill level, can vary with such factors as forebay dissolved gas level, spill patterns and water temperature changes. Also, there are many project-specific limitations on spill levels for reasons other than dissolved gas. These include adult passage, navigation, and research activities. These limitations are typically of

[1] Review of steelhead passage information at McNary Dam indicated that the planning date of April 20 for chinook salmon is applicable to steelhead (Smolt Index Report, PIT-tag data, Fish Passage Center, Portland, Oregon). In some years, steelhead smolts reached McNary before April 20; in some years, after April 20.

short duration but they do reduce spill for fish passage to a limited degree. Dissolved gas and biological monitoring information, and the results of research on spill effectiveness and survival, should be reviewed annually so that specific spill levels can be developed for each project.

Table III-2. Estimated spill caps for the operations specified in this Supplemental FCRPS Biological Opinion.

Project	Estimated Spill Level [2]	Hours	Limiting Factor
Lower Granite	45 kcfs	6 pm - 6 am	gas cap
Little Goose	60 kcfs	6 pm - 6 am	gas cap
Lower Monumental	40 kcfs	6 pm - 6 am	gas cap
Ice Harbor	75 kcfs (night) 45 kcfs (day)	24 hours	nighttime - gas cap daytime - adult passage
McNary	150 kcfs	6 pm - 6 am	gas cap
John Day	180 kcfs/60%[3]	1 hour before sunset to 1 hour after sunrise	gas cap/percentage
The Dalles	64%	24 hours	tailrace flow pattern and survival concerns (study planned in 1998)
Bonneville	120 kcfs (night) 75 kcfs (day)	24 hours	nighttime - gas cap daytime - adult fallback

Comparison of these new spill objectives with those set out in the 1995 FCRPS Biological Opinion is difficult. Whereas the previous spill objectives were defined as a spill percentage, the proposed objectives (which, in most cases, are based on the spillway flows at which gas caps are reached) are described in terms of "kcfs over the spillway." These changes are described in detail in Appendix C ("Basis for NMFS Determinations Concerning the Use of Spill as Mitigation for Operation of the Federal Columbia River Power System") and are briefly outlined for each project below.

Lower Granite: The 1995 FCRPS Biological Opinion set a spill level at Lower Granite of 80% instantaneous spill for 12 hours per day. However, under most conditions, this level of spill could not be implemented because the gas cap was reached at spillway flows of 40 kcfs. The Action Agencies now

[2] The estimates of fish passage efficiency used to derive these spill levels are conservative in that they are based on the guidance efficiencies of hatchery spring/summer chinook instead of those estimated for wild or hatchery steelhead. Estimates for hatchery spring/summer chinook were used because the spill levels set in this Supplemental FCRPS Biological Opinion must be equally protective of the weakest listed stock present in the river during the steelhead outmigration period.

[3] The total dissolved gas cap at John Day Dam is estimated at 180 kcfs and the spill cap for tailrace hydraulics is 60%. At project flows up to 300 kcfs, spill discharges will be 60% of instantaneous project flow. Above 300 kcfs project flow, spill discharges will be 180 kcfs (up to the hydraulic limit of the powerhouse).

estimate that the gas cap will be reached at 45 kcfs and propose this level as the spill limit. Based on radio-tracking studies with adult chinook, performed at Lower Granite Dam during 1996 and 1997, a spill level of 45 kcfs should not adversely affect adult passage (T. Bjornn, fax to R. Kalamasz, S. Pettit, and J. Ceballos, dated April 4, 1998). At a river flow 100 kcfs, the new standard will provide an instantaneous spill level of 45 kcfs and an estimated fish passage efficiency (FPE) of 85%.

It may be necessary to consider a lower spill limit to accommodate safety concerns when juveniles are being loaded directly onto barges and the barges must be docked for extended periods. Spill operations must also consider research needs critical to the proposed evaluation of the prototype surface bypass/collector (i.e., project operations are modified to spill for 24-hours per day instead of only at night and powerhouse operations are modified to provide the required hydraulic conditions in the immediate forebay). Data from this research are critical to the long-term regional decision due by the end of 1999.

The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

Little Goose: The 1995 FCRPS Biological Opinion described a spill level for Little Goose Dam of 80% instantaneous spill for 12 hours per day. As at Lower Granite Dam, the Action Agencies could not usually implement this level because the gas cap was reached at spillway flows of approximately 35 kcfs. The Action Agencies now estimate that the gas cap will be reached at 60 kcfs at this dam and propose this limit. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 60 kcfs should not adversely affect adult passage (C. Perry, Idaho Cooperative Fish and Wildlife Research Unit [ICFWRU] fax to J. Ceballos, NMFS, dated April 9, 1998).

The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

At a river flow of 100 kcfs, the new standard will provide an instantaneous spill level of 60 kcfs and an estimated of FPE of 86%.

Lower Monumental: The 1995 FCRPS Biological Opinion set a spill level at Lower Monumental Dam of 81% of instantaneous spill for 12 hours per day. Again, this level of spill was not provided voluntarily because the gas cap was reached at spillway flows of approximately 40 kcfs. The Action Agencies have not changed this estimate of spill at the gas cap. Therefore, spill levels at this dam are not expected to change during 1998. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 40 kcfs should not adversely affect adult passage (C. Perry, ICFWRU, fax to J. Ceballos, NMFS, dated April 9, 1998). Because the gas cap is currently reached at approximately 40 kcfs, no reduction in spill is necessary between 0500 to 0600 hours. Because spill is limited, the maximum achievable FPE is limited to approximately 61%.

The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

Ice Harbor: The 1995 FCRPS Biological Opinion described spill levels at Ice Harbor Dam of 27% in the spring and 70% in the summer, each for 24 hours per day. The 27% spring objective was often reached, even though the gas cap limited voluntary spill to flows of 25 kcfs. The summer target of 70% was also reached at the lower flow levels. Due to the installation of spillway flow deflectors, the Action Agencies now estimate that the gas cap will be reached at 75 kcfs. Based on research performed during the early 1980's, concerns for adult passage would limit daytime (0500 to 1800) spill to 45 kcfs. However, in view of preliminary information from radio-tracking studies performed during 1996, wherein a spill level higher than 45 kcfs did not adversely impact adult passage (C. Perry, ICFWRU, fax to J. Ceballos,

NMFS, dated April 9, 1998), may require that the 45 kcfs adult passage daytime cap may need to be reconsidered once the final results are available. However, no change is proposed at this time. Additional short-term limits may need to be imposed to address safety concerns when barges are exiting the lock in the downstream direction. Temporary modifications to FPP spill patterns to improve navigation conditions will not be necessary once coffer cell construction below the spillway is completed this coming winter. At a river flow of 100 kcfs, the new standard will provide an instantaneous spill level of 75 kcfs and an estimated spring chinook FPE of 84%.

The BPA has specified 7.5 to 9.5 kcfs as minimum powerhouse flows for system reliability. Because this minimum is dependent on the status of generation at other projects, it may not be necessary at all times.

McNary: The 1995 FCRPS Biological Opinion set a spill level at McNary Dam of 50% for 12 hours per day. Due to limited powerhouse capacity and because the gas cap was reached at spillway flows 120 kcfs, these spill levels were reached under most conditions. The Action Agencies now estimate that the gas cap will be reached at 150 kcfs and proposed this level of spill as the limit. At a river flow of 240 kcfs, the new standard will provide an instantaneous spill level of 150 kcfs and an estimated FPE of 89%. BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

John Day: The 1995 FCRPS Biological Opinion set spill levels of 33% during spring and 86% during summer, 12 hours per day. The gas cap was reached at spillway flows of 20 to 50 kcfs (depending on the spill pattern), prohibiting voluntary spill under most river flow conditions. Because of spill flow deflectors have been installed at this project, the Action Agencies now estimate that the gas cap will be reached at spillway flows of approximately 180 kcfs. The Action Agencies therefore propose a spill limit of 180 kcfs except when river flows are less than approximately 250 to 300 kcfs. At these low flows, poor tailrace conditions at the bypass outfall will limit spill to 60% of the total river flow.

BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

A change in hours to one hour before sunset to one hour after sunrise is also proposed to partially offset the high cost of the increased spill levels at John Day. At a river flow of 240 kcfs, the new standard will provide an instantaneous spill level of 60% and an estimated spring chinook FPE of 79%, from one hour before sunset to one hour after sunrise

The Action Agencies also propose to investigate 24-hour spill at John Day Dam beginning in 1999. The cost and transmission system effects of 24-hour spill at John Day are a concern. However, high spillway effectiveness and high daytime passage were noted during 24-hour spill in 1997 (Corps Memorandum for the Record from Bob Dach, February 3, 1998). This observation, together with the need to evaluate the slight change in spill hours, warrants further investigation. Spill effectiveness was highest during the summer but daytime passage was much higher than expected during both spring and summer, indicating a potential decrease in forebay residence time (and subsequent predator exposure) in this area. The framework for the proposed study is as follows: (1) the study will not exceed two years; (2) the scope of the study will include both spring and summer spill; (3) the test condition will not necessarily involve 24 hour spill seven days per week (i.e., 24-hour spill will be limited temporally in season so as to generate the necessary information with minimal effects on generation and transmission capacity); (4) the study plan will be approved through the Regional Forum process.

Commenters suggested that the 24-hour spill test should be conducted at John Day during 1998. However, it would not be reasonable to implement this test during 1998 because the necessary planning cannot be completed.

The Dalles: The 1995 FCRPS Biological Opinion set a spill level at The Dalles Dam of 64% for 24 hours. Because the gas cap was reached at spillway flows of 230 kcfs, the Opinion spill level was met most of the time. Whereas spill could be increased further before the gas cap was reached, poor tailrace conditions and recent poor survival estimates at high spill volumes are a concern. No change is proposed until planned survival and spill effectiveness studies, planned for 1998, can be completed. However, changes in spill operations at The Dalles may be proposed once this research is completed. Any resulting changes in the annual operation will be coordinated through the Regional Forum process and memorialized through the 1995 RPA Measure 26 consultation Framework or some similar process. At a river flow of 240 kcfs, 64% spill will provide an estimated FPE of 79%.

The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

Bonneville: The 1995 FCRPS Biological Opinion did not recommend specific spill percentages at Bonneville Dam because spill was limited severely by the need for measures to prevent adult fallback. In addition, the gas cap was reached at 120 kcfs spillway flow. Research is to address these issues is needed and no change in spill is proposed at this time. At a river flow of 240 kcfs, the limited spill capability will provide an estimated FPE of 59%.

The BPA has specified a minimum powerhouse flow of 30 kcfs.

Excerpt From: Basis for NMFS Determinations Concerning The Use of Spill as Mitigation for Operation of the Federal Columbia River Power System

Spill and Spill Related Recommendations

For the above-mentioned reasons, NMFS has reconsidered the spill volumes and scenarios contained in RPA Measure 2 of the 1995 FCRPS Biological Opinion. The NMFS has determined that it is reasonable to increase spill volumes beyond the 80%-FPE level at projects where this can be accomplished without exceeding the current TDG cap (or other project-specific limitations) during 1998 and future fish passage seasons. Table C-3 illustrates the differences in FPE and spill amounts (under a given flow scenario) between the recommended spill approach and an 80%-FPE spill approach. The estimated average FPE over the eight FCRPS dams is less than 80% under both strategies. However, the gas cap-limited spill approach results in a somewhat higher overall average FPE.

Table C-3. Estimates of fish passage efficiencies and spill volumes obtainable in 1998 under a 1995 FCRPS Biological Opinion-type spill program (i.e., 80% FPE limit) versus those obtainable with a gas cap-limited spill program (i.e., capped 120% TDG). Unless otherwise specified, 12-hour (i.e., 1800 to 0600) spill is prescribed. (Calculations assume 100 kcfs total flow at LGR and 240 kcfs total flow at MCN.)

Project	1995 BiOp (80% FPE) Approach			Gas Cap Limited Spill Approach		
	Spill Volume (kcfs)	Instant Spill (%)	FPE[4]	Spill Volume (kcfs)	Instant Spill (%)	FPE[5]
LGR	20 (12 hrs)	20	80	45 (12 hrs)	45	85
LGS	25 "	25	80	60 "	60	86
LMN	40 "	40	61	40 "	40	61
IHR	55 (night)	55	80	75 (night)	75	84
	45 (day)	45		45 (day)	45	
MCN	0	0	81	150 (12 hrs)	63	89
JDA	148 (12 hrs)	65	80	180[7] (12 hrs)	60	79
TDA[6]	156 (24 hrs)	64	79	156 (24 hrs)	64	79
BON	120 (night)	50	59	120 (night)	50	59
	75 (day)	31		75 (day)	31	
Ave. FPE			75			78

The specific spill volumes shown in Table C-3 must be viewed as approximate because the total dissolved gas levels measured at the monitoring site below each project, at a given spill level, can vary with such

[4] These FPE's are calculated with the same equation used in Table C-1, however, current FGE and TDG estimates are used. 80% FPE was used to cap spill.

[5] These FPE estimates are based on the same FGE and TDG data but the 120% gas cap and other project specific limitations were used to cap spill (limitations are described in the text below).

[6] Spill will be capped at 64% at this project, see project specific discussion in the text.

[7] The spill level at John Day Dam is capped at 180 kcfs for gas or 60% total flow due to tailrace conditions (see text below).

factors as forebay dissolved gas level, spill patterns, and water temperature changes. Also, there are many project-specific limitations on spill levels other than dissolved gas. These include adult passage, navigation, and research activities. These limitations are typically of short duration but they do reduce spill for fish passage to some degree. The NMFS recommendations for system spill and limits to spill duration for each project are discussed below:

Planning Dates

The actual dates of spill and flow augmentation should be determined annually by the TMT based on inseason monitoring information. Planning dates are April 3 to June 20 and June 21 to August 31 for spring and summer, respectively, in the Snake River; April 10 to June 30 in the mid-Columbia River; and April 20 to June 30 and July 1 to August 31 for spring and summer, respectively, in the lower Columbia River.

Spill Trigger for Lower Snake River Collector Dams

Voluntary spill should occur at Lower Granite, Little Goose, and Lower Monumental Dams when the April 1 volume-of-runoff forecast indicates that seasonal average forecasted flows at Lower Granite Dam are projected to exceed 85 kcfs during the spring migration period (early April to June 20). The NMFS recognizes that, early in the season, voluntary spill may occur when river flows are substantially less than 85 kcfs. It is intended that voluntary spill be maintained to provide equitable spread-the-risk conditions throughout the migration season for the population as a whole.

System Wide Issues

Gas bubble disease monitoring of juvenile and adult salmonids should continue at all the current sites as defined in the NMFS 1998 Gas Bubble Disease Monitoring Plan. It is the determination of the NMFS Dissolved Gas Team (DGT) that the juvenile portion of the monitoring program has been reasonably well validated through the annual research and monitoring that has been conducted since 1994 (Mark Schneider, DGT cochair, pers. comm., March 2, 1998). However, two important research needs remain for the monitoring program: (1) a better understanding of the effects of extremely high near-field TDG levels on all species of salmonid and (2) verification of the adult salmon monitoring program.

Gas abatement studies should continue for all FCRPS dams including Chief Joseph and Grand Coulee Dam (including reducing high Boundary TDG levels). Even though there is no intentional fish passage in this reach, TDG generated by these two dams contributes to system TDG downstream and reduces the ability to provide fish-protective levels of spill at downstream dams.

Tailrace hydraulic conditions should be evaluated through general model studies to determine optimum spill patterns for minimizing the retention time of juveniles in spill basins and tailraces and for minimizing adverse conditions for adult passage at all dams where this has not already been accomplished. These evaluations have been completed for existing conditions at Bonneville, The Dalles and John Day Dams and have been partially completed for Ice Harbor Dam. Very little detailed information exists for McNary, Lower Monumental, Little Goose and Lower Granite Dams, particularly under the potential high spill levels called for in this Supplemental FCRPS Biological Opinion. Scale model studies will allow a timely assessment of tailrace conditions in a stepwise manner through a full range of spill and total flow levels and varied turbine unit operations. After implementation, the final patterns should be verified to the extent possible through field observations.

Information on spill efficiency (flow per fish) and effectiveness (percent of total project passage) is also needed at most FCRPS dams under a variety of spill and flow conditions. Limited information from

radio-tagged juveniles passing several dams under very high flow conditions during 1996 and 1997 indicate that the spill scenarios which are effective for passing juvenile migrants may be different from those effective for passing adults. Information collected at John Day Dam in 1997 indicates that 24-hour spill may be much more effective than 12-hour spill in reducing residence time in the forebay (by allowing juvenile fish to pass as soon as they approach the dam). This study also indicated that, for some species, daytime spill may be more effective than nighttime spill. If spill is limited to 12 hours for adult concerns, these studies can help identify which 12 hours are best. It is likely that the John Day Dam example would hold true for other FCRPS dams.

Studies of spill effectiveness would also allow more accurate estimates of the smolt-to-adult return (SAR) rates of PIT-tagged fish released in the hydrosystem. Computation of SARs requires that the total number of smolts passing each project be estimated from rates of detection in the juvenile bypass system. This requires an accurate estimate of the percent of total project passage via the spillway versus the powerhouse. Spill effectiveness studies would provide the needed information.

Spillway survival estimates are needed for all dams under a variety of total flow and spill conditions. Currently, spill patterns and volume limitations are developed with physical models of the dams at the Corps' Waterways Experiment Station based on general and somewhat subjective estimates of the stilling basin retention time of juveniles, predation risk to juveniles, and adult-passage concerns. The current studies are set up to assess adult passage through the tailraces of FCRPS dams but very little effort has been made to estimate the effects these management options would have on juvenile survival.

Lower Granite Dam

The 100 kcfs spill trigger specified in the 1995 FCRPS Biological Opinion has been reduced to 85 kcfs. Spill operations for fish passage must also consider critical research data needs relating to the proposed evaluation of the prototype surface bypass/collector during spring 1998, and potentially, 1999. The federal parties have reached agreement on voluntary spill hours, spill volume, and powerhouse turbine operations during spring 1998. Specifically, during the spring SBC evaluation, spill will occur 24 hours per day with a minimum flow of 5.8 kcfs and a preferred maximum of 35 kcfs. Turbine unit operating priority will be units 1, 4,5,3 and 6. Unit 6 will not be operated unless necessary to control total dissolved gas saturation. In the absence of special operations for research, 12-hour nighttime spill to the 45-kcfs TDG cap will occur. The Action Agencies' preferred operation during the spring of 1998 is to maintain a constant powerhouse load (unit 1 @19.9 kcfs, and units 3,4,5 @15.5 kcfs).

Dissolved gas limitations - Depending on ambient forebay gas levels, spill to 120% TDG saturation will limit spillway flows to about 45 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity within one percent of peak efficiency is normally about 123 kcfs. However, in 1998, unit 2 will be out of operation and powerhouse capacity will be reached at flows of approximately 103 kcfs. Total river flows above this volume will cause involuntary spill. The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum depends on the status of generation at other projects, it may not be necessary at all times. The Corps' Fish Passage Plan (FPP) specifies that units 1, 2, and 3, be given operating priority for fish passage during the daytime and the larger units (4, 5, and 6) be given priority at night.

Tailrace limitations - It may be necessary to limit spill in order to limit the occurrence of adverse hydraulic conditions in the tailrace. Poor hydraulic conditions resulting in large tailrace eddies can reduce adult passage efficiency and increase predation on juveniles passing through the spillway and bypass system. Based on radio-tracking studies with adult chinook, performed at Lower Granite Dam during 1996 and 1997, a spill level of 45 kcfs should not adversely affect adult passage (T. Bjornn fax to R. Kalamasz, S. Pettit, and J. Ceballos, dated April 4, 1998). It may be necessary to consider a lower limit to accommodate safety concerns when the project is direct-loading. The Corps has not

conducted the specific modeling studies of tailrace spill patterns at Lower Granite that might identify other limits to spill. However, it is known that a large eddy forms below the powerhouse as spill levels increase. The formation and the size and shape of the eddy vary with spill level and turbine unit operations. Until modeling studies can be performed, the need for spill limitations to minimize this eddy will be assessed inseason by the TMT.

Little Goose Dam

Continue 12-hour nighttime spill at this project. PIT-tagged fish will be returned to the river after detection whereas other collected fish will be transported. Barge loading, which normally occurs in the late afternoon, can be hampered when two barges are in tow. A new secondary bypass system was installed for the 1997 season which releases bypassed smolts into positive downstream flow conditions.

Dissolved gas limitations - Depending on ambient forebay gas concentrations, spill to 120% TDG saturation will limit spillway flows to about 60 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 123 kcfs. The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum depends on the status of generation at other projects, it may not be necessary at all times. The FPP specifies that units 1, 2, and 3, be given operating priority for fish passage during the daytime and that the larger units (4, 5, and 6) be given priority at night.

Tailrace limitations - It may be necessary to limit spill in order to limit the occurrence of adverse hydraulic conditions in the tailrace. Poor hydraulic conditions resulting in large tailrace eddies can reduce adult passage efficiency and increase predation on juveniles passing through the spillway and bypass system. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 60 kcfs should not adversely affect adult passage (C. Perry, Idaho Cooperative Fish and Wildlife Research Unit [ICFWRU] fax to J. Ceballos, NMFS, dated April 9, 1998). Specific modeling studies of tailrace spill patterns, for the purpose of identifying other limitations to spill at Little Goose, have not been conducted. However, inseason observations indicate that an eddy forms below the powerhouse at spill levels as low as 35%. The need for spill limitations to minimize this eddy will be assessed inseason by the TMT.

Lower Monumental Dam

Continue 12-hour nighttime spill at this project. PIT-tagged fish will be returned to the river after detection whereas other collected fish will be transported.

Dissolved gas limitations - Depending on ambient forebay gas levels, spill to the 120% TDG saturation will be limited to spillway flows of about 40 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 123 kcfs. The BPA has specified 11.5 kcfs as a minimum powerhouse flow for system reliability. Because this minimum depends on the status of generation at other projects, it may not be necessary at all times. The FPP specifies that units 1, 2, and 3, be given operating priority for fish passage.

Tailrace limitations - Adverse hydraulic conditions (eddy at JBS outfall) during periods of high spill (spillway flows of 60 to 70 kcfs) have been observed at this project but have not yet been calibrated. Inseason observations indicate that spill levels of 50% or less may be necessary to minimize the eddy below the powerhouse. Due to the lack of specific data, the need for spill limitations to minimize this eddy will be assessed inseason by the TMT. Based on radio-tracking studies with adult chinook, performed during 1997, a spill level of 40 kcfs should not adversely affect adult passage (C. Perry, ICFWRU, fax to J. Ceballos, NMFS, dated April 9, 1998).

Navigation limitations - Barge loading for the juvenile transportation program normally occurs in the evening hours and has in the past been hampered by voluntary spill. A new mooring dolphin has been installed and is expected to allow spill to continue during barge loading in 1998 and future years. However, spill it may be necessary to temporarily reduce spill to accommodate the loading process.

Ice Harbor Dam

Hydroacoustic studies conducted by BioSonics, Inc., for the Corps have indicated a relatively flat diel passage distribution for juvenile migrants through this spillway. This passage pattern supports continued 24-hour spill this project.

Dissolved gas limitations - Spillway flows at Ice Harbor Dam will increase due to the additional spill deflectors installed during 1997. Spillway flows resulting in 120% TDG saturation (with eight of ten spillbays equipped with deflectors) is anticipated to be approximately 75 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 94 kcfs. The BPA has specified 7.5 to 9.5 kcfs as the range of minimum powerhouse flows for system reliability. Because this range of minimum flows is related to the status of generation at other projects, it may not be necessary at all times. The FPP specifies that units 1,3, 4, and 2, be given operating priority for fish passage.

Tailrace limitations - It may be necessary to reduce spill levels as spill levels approach total river flow levels in order to maintain good hydraulic conditions in the tailrace. Poor hydraulic conditions resulting in large tailrace eddies can reduce adult passage efficiency and increase predation on juveniles passing through the spillway and bypass system. Preliminary modeling studies of tailrace spill patterns have been conducted for the purpose of optimizing spill patterns, however, specific spill volume limitations (other than for barge traffic) have not been determined. Past radio-tracking studies on adult passage indicate that a daytime spill cap of approximately 45 kcfs is necessary to maintain good adult passage (Turner et al. 1984). This daytime cap should be in effect from 0500 to 1800 hours. Preliminary data indicate that a spill level higher than 45 kcfs appears not to adversely impact adult passage (C. Perry, ICFWRU, fax to J. Ceballos, NMFS, dated April 9, 1998). However, no change is proposed for the 1998 season.

Navigation limitations - Under current conditions, spill flow presently causes problems for barge traffic exiting the navigation lock when river flows exceed 100 kcfs. The Corps has indicated that they will reduce spill as long as is necessary to pass navigation traffic. An alternative spill schedule for this purpose is included in the Corps' Fish Passage Plan. Temporary modifications to FPP spill patterns to improve navigation conditions will not be necessary once coffer-cell construction below the spillway is completed during the winter of 1998-99.

McNary Dam

Continue 12-hour nighttime spill and the secondary bypass of juvenile salmonids back to the river.

Dissolved gas limitations - Depending on ambient forebay gas levels, spillway flows at which the 120% TDG cap is reached may range between 120 and 160 kcfs.

Powerhouse flow limitations - Powerhouse hydraulic capacity with unit operation within one percent of peak efficiency is approximately 170 to 175 kcfs. This low capacity will cause involuntary spill to occur at normal spring flow levels. The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability. The FPP specifies that units 1,2, and 3 be given operating priority for fish passage.

Tailrace limitations - A reduction in spill levels may be required at high spill percentages to maintain good hydraulic conditions for juvenile and adult passage in the tailrace. However, observations in the tailrace during high spillway flows have not indicated a problem. This may be due to the bathymetric and shoreline configuration of this tailrace which tends to force powerhouse flow in a northwesterly direction (i.e., toward the spillway side of the river) as it moves downstream.

Nevertheless, because specific modeling of tailrace spill patterns for the purpose of identifying limitations to spillway flow under a variety of flow and unit operation conditions, the need for limitations should be assessed inseason by the TMT.

John Day Dam

Spill at John Day Dam will increase during 1998 due to completion of spillway flow deflectors during late 1997. Twenty-four hour spill should be investigated during 1999. High spillway effectiveness and high daytime passage were noted during 24-hour spill studies performed during 1997 (Memo for the Record from B. Dach, U.S. Army Corps of Engineers, February 3, 1998). Effectiveness was highest during the summer but daytime passage was much higher than expected during both spring and summer indicating a potential decrease in forebay residence time and subsequent predator exposure in this area.

Dissolved gas limitations - Nearfield TDG tests conducted during early 1998 indicate that spill volumes generating 120% TDG may be as high as 180 kcfs. Actual spill volumes will have to be determined in season because forebay gas level will probably affect this estimate.

Powerhouse flow limitations - The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

Tailrace limitations - Spill volume at this project will be limited by tailrace conditions under high spill percentages and medium-to-low total river volume. In the gas cap-limited spill scenario illustrated in Table C-3 (above), 144 kcfs out of 240 kcfs total flow (i.e., 60%) was spilled. Based on modeling studies at the Corps' Waterways Experiment Station, under a variety of simulated flow levels, this percentage of spill is the maximum that does not cause the formation of a large eddy below the powerhouse, particularly in the vicinity of the juvenile outfall. These modeling studies also indicated that at least 25-percent spill was needed to create acceptable tailrace conditions below the spillway. Additional modeling studies, scheduled prior to the start of the 1998 spill season, will help refine these limits.

The Dalles Dam

No change is recommended to the current spill scenario at The Dalles Dam (other than those necessary for research) until the ongoing spill studies are completed. Research completed to date indicates that this spillway is not a benign passage route although it may be very efficient in passing fish. After one year of research, the survival study has indicated that, under very high spill levels (greater than 250 kcfs), the survival of the test fish (coho and subyearling chinook) was lower than anticipated (86% to 93%) (Dawley et al. 1998 - Draft Report). The survival of subyearling chinook was higher. These fish were passed through the system under lower spill levels, indicating a possible connection between spill volume and survival. Also, percentages of spill greater than about 40% send increasing amounts of water and fish over shallow rocky shelves just downstream of the spillway. Fish swept into these areas are more likely to fall victim to predation than fish that stay in the main channel. It is unknown if this predation reduces spill survival to something less than turbine survival. However, increasing spill above the 40% level is likely to move in the direction of increased harm. More information is needed before any management changes are warranted. Any spill management changes indicated by the results of survival and spill effectiveness studies at The Dalles Dam will be implemented in a timely manner through the Regional Forum process.

Dissolved gas limitation - Depending on ambient dissolved gas levels in the forebay, the 120% TDG cap can be as high as 230 kcfs at this project.

Powerhouse flow limitations - The BPA has specified a minimum powerhouse flow of 50 kcfs to maintain power transmission system stability.

Tailrace limitations - Because of NMFS concern for juvenile survival through the spillway at high spill percentages and volumes, it is recommended that spill be limited to the 1995 FCRPS Biological Opinion level of 64% (rather than spilling to the TDG gas cap). The ongoing studies on passage survival and spill efficiency and effectiveness must be completed. In addition, and pending results of another year of survival studies, scoping should begin on methods to improve spillway survival at this dam (e.g., reconfigure the hydraulic characteristics of the stilling basin to reduce juvenile residence time).

Research limitations - Limited hydroacoustic data from 1996 studies indicate that 30% spill may be as effective at passing fish as the 64% required in 1995 RPA Measure 2 (BioSonics, Inc. 1997). Unfortunately, only three days of valid tests were completed at the 30% spill level. Additional tests during 1998 will help define this issue. Spill will be limited to 30% for approximately 50% of the 1998 fish passage season.

Bonneville Dam

No change is recommended to the Bonneville Dam spill scenario at this time. Spill, and therefore FPE, is limited by a relatively low TDG cap and by concerns for adult fallback during the daylight hours. These two issues should be the focus of continued research. Specifically, the Action Agencies should continue the ongoing project-specific gas abatement program for Bonneville Dam with focus on evaluating endbay flow deflectors and eliminating deep holes in the near tailrace. This work must also consider the effects that the implementation of gas abatement measures may have on passage and the safety of adult and juvenile salmonids. The ongoing study to reduce fallback of adults through the spillway should be expedited.

Dissolved gas limitation - Depending on ambient forebay dissolved gas levels, the 120% TDG cap is in the 100 to 150 kcfs range and averages about 120 kcfs at this project.

Powerhouse flow limitations - The BPA has specified a minimum powerhouse flow of 30 kcfs.

Tailrace limitations - The current spill pattern for Bonneville Dam was determined in modeling studies conducted in the early 1990's. These same studies indicated that a minimum spill level of 50 kcfs was necessary for adequate tailrace hydraulic conditions. There is no maximum spillway flow cap for fish passage. Because of the unique configuration of Bonneville Dam, flow from the spillway does not directly affect tailrace patterns below either of the two powerhouses.

Adult fallback limitation - Adult fallback through the spillway is known to be correlated to spill flow (Monan and Liscom 1975). The current spill cap for daylight hours is 75 kcfs.