March 2010

APPENDIX E

OPERATIONS RELATED TO PROJECT SPILL FOR FISH PASSAGE

FISH OPERATIONS PLAN

CENWD-PDD March 2010

2010 Spring Fish Operations Plan

INTRODUCTION

The 2010 Spring Fish Operations Plan (FOP) describes the U.S. Army Corps of Engineers' (Corps) planned operations for fish passage at its mainstem Federal Columbia River Power System (FCRPS) dams during the 2010 spring fish migration season; generally April through June. The 2010 Spring FOP is consistent with the 2009 Court ordered spring spill operations with the exception of a spring transport proposal under low river discharge conditions when the seasonal regulated flow is ≤65 kcfs[1] at Lower Granite Dam. The 2010 Spring FOP is consistent with the adaptive management provisions in the 2008 NOAA Fisheries FCRPS Biological Opinion (2008 BiOp) as implemented through the Adaptive Management Implementation Plan (AMIP), and the Corps' Record of Consultation and Statement of Decision (ROCASOD) adopting the project operations contained in the 2008 BiOp and Columbia Basin Fish Accords (Accords).

As in 2009, the 2010 Spring FOP incorporates planned project operational adjustments necessary to conduct essential research to accommodate the installation or adjustment of fish passage features for the 2010 spring migration season. Other FCRPS water management actions and project operations not specifically addressed in this document shall be consistent with the 2008 BiOp and other guiding operative documents including the 2010 Water Management Plan (WMP), seasonal WMP updates, and the 2010 Fish Passage Plan (FPP). As in 2009, operations described herein may be adjusted to address in-season developments through discussion and coordination with regional sovereigns.

The following sections describe factors that influence management of fish operations during various runoff conditions, including: total dissolved gas (TDG) management, spillway operations, minimum generation requirements, operations under low flow conditions, navigation safety, juvenile fish transportation operations, specified spring operations for fish at each mainstem project, protocols for fish protection measures related to operational emergencies, coordination with regional entities, and monthly reporting.

GENERAL CONSIDERATIONS FOR FISH OPERATIONS

For planning purposes, the Corps' 2010 Spring FOP assumes average runoff conditions. However, because actual runoff conditions vary in timing and shape and may be higher or lower than average in any given year, adjustments in fish transportation and/or spill operations (kcfs discharge levels, spill percentages, or spill caps) will be adaptively

[1] The seasonal average flow projections will be based on the Corps' STP model and the April final forecast for Lower Granite Dam for the April 3 through June 20 time period (available by April 7, 2010).

managed in-season. These in-season changes will be coordinated through the Technical Management Team (TMT) and other appropriate regional forums, to avoid or minimize poor juvenile or adult fish passage conditions, navigation safety concerns, or to accommodate powerhouse and/or transmission system constraints. Actual spill levels may be adaptively managed to accommodate fish research or other conditions and will be coordinated through the TMT and other appropriate regional forums.

Management of Spill for Fish Passage

The Corps will manage spill for fish passage to avoid exceeding 120% TDG in project tailraces, and 115% TDG in the forebay of the next project downstream consistent with the current State of Washington TDG saturation upper limits.[2] These levels are referred to as "gas caps." The project maximum spill discharge level that meets, but does not exceed the gas cap, is referred to as the "spill cap." Gas caps are constant, whereas spill caps may vary daily depending on flow, spill pattern, temperature, and other environmental conditions.

As noted above, the spill levels presented below in Table 2 are planned spill operations and assume average runoff conditions; however, adjustments to these spill rates may be necessary. Reasons for these adjustments may include:

1. Low runoff conditions that may require adjustments in spill level while still meeting project minimum generation requirements.
2. High runoff conditions where flows exceed the powerhouse hydraulic capacity with the specified spill rates.
3. Navigation safety concerns.
4. Generation unit outages that reduce powerhouse capacity.
5. Power system or other emergencies that reduces powerhouse discharge.
6. Lack of power demand resulting in an increase of spill level.

The Corps' Reservoir Control Center (RCC) is responsible for daily management of spill operations responsive to changing TDG conditions. In order to manage gas cap spill levels consistent with the states' TDG saturation limits, the RCC establishes the spill caps for each project on the lower Columbia and Snake rivers on a daily basis throughout the fish passage season. These spill caps are set so that resultant TDG percent saturation levels are not expected to exceed the 120%/115% TDG limits measured as the average of the highest 12 hourly readings each day.

Within any given day, some hours of measured TDG levels may be higher or lower than the gas caps due to changing environmental conditions (wind, air temperature, etc.). The process of establishing daily spill caps entails reviewing existing hourly data at each dam (including flow, spill, temperature, and TDG levels) and taking into consideration a number of forecast conditions (including total river discharge, powerhouse discharge,

[2] In February 2009, the State of Oregon modified its waiver for 2009 to remove the 115% forebay TDG limit. However, the Corps will continue to manage to 120% and 115% (the Washington TDG standard) in 2010.

wind and temperature forecast, etc.). These data are used as input variables into the System TDG (SYSTDG) model. The SYSTDG model estimates TDG levels expected several days into the future and is a tool integral to daily decision-making when establishing spill caps at individual dams. Spill caps set by RCC and contained in the daily spill priority list will be met at the projects using the individual project spill pattern(s) contained in the FPP Sections 2 through 9, which most closely correspond to the specified spill level (i.e. may be slightly over or under the specified spill discharge or percent value). During the spring freshet, when river discharge may be greater than project powerhouse hydraulic capacity given the specified Spring FOP spill level, or a lack of power load results in an increase in the spill level, the Corps will attempt to minimize TDG on a system-wide basis. In this case, spill caps are also developed for 125%, 130%, or 135% saturation as a means of minimizing TDG throughout the system.

The Corps will initiate spill at 0001 hours, or shortly after midnight, at each of the projects on the start dates specified in the project sections below. Spill caps will be established at the specified levels and will continue unless conditions require changing to maintain TDG within the upper limits of 120% in the tailwater of a dam and 115% in the forebay of the next project downstream (and at Camas/Washougal). Spill will transition to summer levels at 0001 hours, or shortly before midnight, at each project on the end dates specified. Operations to manage TDG will continue to be coordinated through the TMT.

Spillway Operations

The Action Agencies will meet the specified spill levels to the extent feasible; however, actual hourly spill levels at each dam may be slightly more or less than those specified in Table 2. Actual spill levels vary depending on the precision of spill gate settings, flow variations in real time, varying project head (the elevation difference between a project's forebay and tailwater), automatic load following, and other factors.

Operations Considerations:

- Spill discharge levels: Project spill levels listed in Table 2 coincide with specific gate settings in the FPP project spill pattern tables. Due to limits in the precision of spill gates and control devices, short term flow variations, and head changes, it is not always possible to discharge the exact spill levels stated in Table 2, or as stated in RCC spill requests (teletypes) to projects that call for discrete spill discharges. Therefore, spillway gates are opened to the gate settings identified in the FPP project spill pattern tables to provide spill discharge levels that are the closest to the prescribed spill discharge levels.

- Spill percentages: Spill percentages are considered target spill levels. The project control room operator and BPA duty scheduler calculate spill levels to attempt to be within ±1% of the target percentage for the following hour (or more than ±1% at Little Goose Dam as specified in Table LGS-13 of FPP Section 8 when river discharge is less than 38 kcfs; or up to ±3.5% at The Dalles Dam when total river

discharge is less than 300 kcfs). Prescribed or specified percentages in Table 2 may not always be attained due to low discharge conditions, periods of minimum generation, spill cap limitations, temporary spill curtailment for navigation safety, and other unavoidable circumstances. Operators and schedulers review the percentages achieved during the day and adjust spill rates in later hours, with the objective of ending the day with a daily average spill percentage that achieves the specified spill percentage.

Minimum Generation

The Corps has identified minimum generation flow values derived from actual generation records when turbines were operating within ±1% of best efficiency (Table 1). Values stated in Table 1 are approximations and do not account for varying head or other small adjustments in turbine unit operation that may result in variations from the reported minimum generation flow and spill amount. Conditions that may result in minor variations include:

1. Varying pool elevation: as reservoirs fluctuate within the operating range, flow rates through the generating unit change.
2. Generating unit governor "dead band": the governor controls the number of megawatts the unit should generate, but cannot precisely control a unit discharge; variations may be 1-2% of generation.
3. System disturbances: once a generator is online and connected to the grid, it responds to changes in system voltage and frequency. These changes may cause the unit to increase discharge and generation slightly within an hour. Individual units operate differently from each other and often have unit specific constraints.
4. Generation control systems regulate megawatt (MW) generation only; not discharge through individual turbine units.

All of the lower Snake River powerhouses may be required to keep one generating unit on line at all times for power system reliability under low river discharge conditions, which may result in a reduction of spill at that project. All of the Snake River projects have two “families” of turbines with slightly different capacities – small and large. In most cases during low flow conditions, one of the smaller turbine units (with reduced generation and flow capabilities) will be online. The smaller turbine units are generally numbered 1–3 and are the first priority for operation during the fish passage season. If smaller turbine units are unavailable, larger units may be used instead. At Little Goose, turbine unit 1, the first priority unit during fish passage, typically operates at the upper end of the ±1% of best efficiency range for the purpose of providing tailrace conditions that are favorable for juvenile and adult fish passage.

During low river discharge events, generally the operating unit runs at the lower end of the ±1% of best efficiency range. However, at Lower Monumental, turbine unit 1, which is the first priority unit during fish passage, has welded blades and consequently cannot operate at the low end of the design range. Also, Ice Harbor turbine units cannot be operated at the lower end of the ±1% of best efficiency range. At a generation level

somewhat higher than the lower ±1% limit, these units experience cavitation which damages the turbine runner and can be detrimental to fish. Therefore, Ice Harbor turbine units will operate at their lower cavitation limits. Minimum generation flow ranges at McNary, John Day, and The Dalles are 50-60 kcfs; and 30-40 kcfs at Bonneville as shown in Table 1.

Table 1.— Minimum generation ranges for turbine units at the four lower Snake and four lower Columbia River dams.

Project	Turbine Units	Minimum Generation (kcfs)
Lower Granite	1-3	11.3-13.1
	4-6	13.5-14.5
Little Goose	1-3	11.3-13.1
	4-6	13.5-14.5
Lower Monumental	1	16.5-19.5
	2-3	11.3-13.1
	4-6	13.5-14.5
Ice Harbor	1-6	8.5-10.3
McNary	N/A	50-60
John Day	N/A	50-60
The Dalles	N/A	50-60
Bonneville	N/A	30-40

Low Flow Operations

Low flow operations at lower Snake River projects are triggered when inflow is not sufficient to meet both minimum generation requirements and planned spill levels in Table 2. In these situations, Snake River projects will operate one turbine unit at minimum generation and spill the remainder of flow coming into the project. Columbia River projects will also operate at minimum generation and pass remaining inflow as spill down to minimum spill levels under low flow conditions. As flows transition from higher flows to low flows, there may be situations when flows recede at a higher rate than forecasted. In addition, inflows provided by non-Federal projects upstream are often variable and uncertain. The combination of these factors may result in instances where unanticipated changes to inflow result in forebay elevations dropping to the low end of the Minimum Operating Pool (MOP). Consequently, maintaining minimum generation and the target spill may not be possible on every hour since these projects have limited operating flexibility.

During low flow conditions when the navigation lock is being emptied at some projects, the total spill volume remains constant, but the spill reported as a percent of total flow may be temporarily reduced below the target spill percentage. This occurs because the volume of water needed to empty the navigation lock during periods of low flow is a greater percentage of the total flow than when river flows are higher.

At Little Goose Dam, when daily average flows in the lower Snake River are ≤32 kcfs, achieving 30% spill requires switching turbine operations between operating 2 units at the low end of the ±1% of best efficiency range to operating one unit at the high end of the ±1% of best efficiency range. This operation is incompatible with the more constant discharge upstream at Lower Granite Dam. It is also often difficult to achieve the FOP prescribed spill level downstream at Lower Monumental Dam and maintain MOP operations. In 2009, through coordination with TMT during low flow periods, Little Goose spill operations changed from 30% to a flat spill level of approximately 7-11 kcfs to smooth out Little Goose discharges, meet Lower Monumental spill levels, and maintain the MOP operating range at Little Goose. If necessary in 2010, a similar operation, modified as necessary to include any configuration or operational changes, will be implemented during low flow periods after coordination with TMT. It is presumed this condition will be alleviated by following the newly developed Little Goose spill pattern tables located in the FPP Section 8. The new tables call for removing the spillbay weir from service within three business days after the daily average flow drops below 38 kcfs for three consecutive days. An alternative low flow operation may be to operate the spillway weir in a summer or high-crest configuration using the 2009 high-crest spill pattern table. This alternative would continue operation of the spillway weir without "training spill" to a lower total river discharge with the objective of meeting the 30% spill target. If total river discharge dropped to a point where maintaining 30% spill was no longer possible, the spillway weir would be closed and spill would be provided through conventional spillbays at either 30% or at a flat kcfs discharge as described above in coordination with the TMT.

Operations during Rapid Load Changes

Project operations during hours in which load and/or intermittent generation changes rapidly may result in not meeting planned hourly spill level because projects must be available to respond to within-hour load variability to satisfy North American Electric Reliability Council (NERC) reserve requirements ("on response"). This usually occurs at McNary, John Day and The Dalles dams. In addition to within-hour load variability, projects on response must be able to respond to within hour changes that result from intermittent generation (such as wind generation). During periods of rapidly changing loads and intermittent generation, projects on response may have significant changes in turbine discharge within the hour while the spill quantity remains the same within the hour. Under normal conditions, within-hour load changes occur mostly on hours immediately preceding and after the peak load hours, however, within-hour changes in intermittent generation can occur at any hour of the day. Due to the high variability of within-hour load and intermittent generation, these load swing hours may have a greater instance of reporting actual spill percentages that vary more than the ±1% requirement than other hours.

Turbine Unit Testing around Maintenance Outages

Turbine units may be operationally tested for up to 30 minutes by running the unit at speed no load and various loads within the 1% of best efficiency range to allow pre-

maintenance measurements and testing, and to allow all fish to move through the unit. Units may be operationally tested after maintenance or repair efforts but before a unit comes out of a maintenance or forced outage status. Operational testing may consist of running the unit for up to 30 minutes before it is returned to operational status. Operational testing of a unit under maintenance is in addition to a unit in run status (e.g. minimum generation) required for power plant reliability. Operational testing may deviate from unit operating priorities and may use water that would otherwise be used for spill if the running unit for reliability is at the bottom of the ±1% of best efficiency range. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized. The Corps will coordinate this testing with the region through the Fish Passage Operations and Maintenance Coordination Team (FPOM).

Navigation Safety

Short-term adjustments in spill may be required for navigation safety, primarily at the lower Snake projects, but may also be necessary at the lower Columbia projects. This may include changes in spill patterns, reductions in spill discharge rates, or short-term spill stoppages. In addition, unsteady flow at Little Goose due to switching between operating one and two units during low flow conditions may impact that project's reservoir elevation and cause inadequate navigation depths at the downstream entrance to the Lower Granite navigation lock. Therefore, adjustments to pool elevation in the Little Goose pool of up to 1.0 ft. above the MOP operating range may be necessary to accommodate safe entrance to the navigation lock at Lower Granite Dam during periods of low flow (approximately 50 kcfs or less) and will be coordinated in TMT. These adjustments may be necessary for both commercial tows and fish barges.

JUVENILE FISH TRANSPORTATION PROGRAM OPERATIONS

As noted above, the Corps' planned spill operations assume average runoff conditions. In previous years, the FOP provided that spill for fish passage would occur under all flow conditions.[3] To improve survival of juvenile migrants the 2008 BiOp, relying on the best available scientific information, calls for maximized transportation beginning on April 3 in exceptionally low water years when the seasonal regulated flow is ≤65 kcfs at Lower Granite Dam. This is accomplished by stopping spill at the three collector projects, Lower Granite, Little Goose, and Lower Monumental dams and diverting fish through the bypass facilities for collection and transport.

After reviewing the updated best available scientific information, NOAA recommends that if the 2010 seasonal regulated flow conditions are ≤65 kcfs in the lower Snake River, as currently predicted, transportation operations should be maximized beginning no

[3] The 2009 FOP provided: "In exceptionally low water years, when the projected seasonal average flow is less that 70 kcfs, the Corps will begin transportation on April 20 at all three Snake collector projects. Spill for fish passage will occur under all flow conditions."

earlier than April 20 at Lower Granite, April 24 at Little Goose, and April 27 at Lower Monumental Dam; and beginning no later than May 1 at Lower Granite, May 5 at Little Goose, and May 8 at Lower Monumental Dam. This recommendation is based on data from recent years (2006-2008), in particular data from 2007 a low flow year and represents a delay in initiating maximum transport compared to the 2008 BiOp.[4] NOAA developed a low flow (≤65 kcfs) transportation proposal and rationale, which was submitted to the Independent Science Advisory Board (ISAB). The ISAB has agreed to review the proposal and provide feedback to NOAA by April 9.

If the April final water supply forecast indicates a seasonal regulated flow of ≤65 kcfs in the lower Snake River, the Corps and NOAA, in coordination with the regional sovereigns, will consider the best available science, including the ISAB input, to make a final determination on the transportation operations.

The following describes the proposed transportation operations for the lower Snake River projects for average water conditions as well as exceptionally low water conditions. Detailed descriptions of project and transport facility operations to implement the program are contained in the FPP Appendix B.

Lower Snake River Dams - Operation and Timing

If the Snake River projected seasonal average (April 3 – June 20) regulated flow is >65 kcfs, the Corps will initiate transportation at Lower Granite Dam no earlier than April 20 and no later than May 1. Transportation will start up to 4 days and up to 7 days after the Lower Granite Dam start date at Little Goose and Lower Monumental dams, respectively. The actual start date for Lower Granite, Little Goose, and Lower Monumental dams will be determined through coordination with TMT as informed by the in-season river condition (e.g. river flow and temperature) and the status of the juvenile Chinook and steelhead runs (e.g. percentage of runs having passed the project).

If 2010 is an exceptionally low water year with projected seasonal average flows ≤65 kcfs, as noted above, the Corps will review the ISAB recommendation and determine transportation schedule and operations in coordination with NOAA, regional sovereigns, and the TMT.[5]

The collection of fish at lower Snake River projects for transportation will commence at 0700 hours on the agreed to start dates. Barging of fish will begin the following day and collected juvenile fish will be barged from each facility on a daily or every-other-day basis (depending on the number of fish) throughout the spring. Transport operations will be carried out at each project in accordance with all relevant FPP operating criteria.

[4] April 3–June 21, 2007 seasonal regulated flow average was 61.2 kcfs at Lower Granite Dam.
[5] The Corps will review the seasonal average flow projections based on the May final water supply forecast along with the Corps' latest STP model run (both available by May 7), and may adjust spill and transport operations following coordination with the TMT.

Transportation and spill operations may be adjusted due to research, conditions at fish collection facilities such as overcrowding or temperature extremes, through the adaptive management process with FPOM and/or TMT to better match juvenile outmigration timing or achieve/maintain performance standards.

SPRING SPILL OPERATIONS

Lower Snake River Projects

Spring spill will begin on April 3 at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams. Spring spill operations will continue through June 20. However, fish run timing and research schedules may require an earlier transition date to summer operations to assure that research occurs during the bulk of the migration. Such changes will be coordinated through TMT. Spring spill levels for Snake River dams are shown in Table 2.

Lower Columbia River Projects

Spring spill will begin April 10 at McNary, John Day, The Dalles, and Bonneville dams. Spring spill operations will continue through June 30 at John Day, and The Dalles dams, through June 19 at McNary Dam, and through June 20 at Bonneville Dam. However, fish run timing and research schedules may require earlier transition dates to summer spill operations to assure that research occurs during the bulk of the migration. Such changes if necessary will be coordinated through the TMT. Spring spill operations are shown in Table 2.

PROJECT BY PROJECT SPRING OPERATIONS

The following sections describe 2010 spring spill operations for each project. Included in the descriptions are planned research activities identified in the 2008 BiOp. The Corps, regional fishery agencies, and Tribes are interested in the continuation of project research studies under the Corps' Anadromous Fish Evaluation Program (AFEP). These studies have been evaluated through the annual AFEP review process with the regional fishery agencies and Tribes, with the study designs being finalized prior to initiation in 2010. The studies are intended to provide further information on project survival that will help inform the region in making decisions on future operation and configuration actions to improve fish passage and survival and meet BiOp performance standards at the lower Snake and Columbia River dams.

Table 2.— Summary of 2010 spring spill levels at lower Snake and Columbia River projects.[6]

Project	Planned 2010 Spring Spill Operations (Day/Night)	Comments
Lower Granite	20 kcfs/20 kcfs	Same as 2009
Little Goose	30%/30%	Same as 2009
Lower Monumental	Gas Cap/Gas Cap (approximate Gas Cap range: 20-29 kcfs)	Same as 2009
Ice Harbor	**April 3-April 28:** 45 kcfs/Gas Cap **April 28-June 20:** 30%/30% vs. 45 kcfs/Gas Cap (approximate Gas Cap range: 75-95 kcfs)	Same as 2009
McNary	40%/40%	Same as 2009
John Day	**Pre-test:** 30%/30% **Testing:** 30%/30% vs. 40%/40%	Same as 2009
The Dalles	40%/40%	Same as 2009
Bonneville	100 kcfs/100 kcfs	Same as 2009

Lower Granite

Spring Spill Operations April 3 through June 20, 2010: 20 kcfs 24 hours per day.

Changes in Operations for Research Purposes:

- Spring research operations: There will be no special spill operations for research in 2010. Established spill patterns as described in FPP Section 9 will be used in 2010.

Operational Considerations:

- Lack of power load or unexpected unit outages could cause involuntary spill at higher total river discharges that could result in exceeding the gas cap limits.

[6] Table 2 displays in summary form planned spring spill operations, however, more specific detail governing project operations is in the section entitled "Spring Fish Operations By Project."

- During periods of high spring runoff when involuntary spill occurs, there may be periods where spill levels create unsafe hydraulic conditions for fish transportation barges entering and exiting the tailrace and/or while moored at the fish loading facility. If such runoff conditions occur, spill may be reduced temporarily when fish transport barges approach or leave the barge docking area or are moored at loading facilities. If conditions warrant a spill reduction, Lower Granite pool MOP elevation restrictions will likely be temporarily exceeded until the barge exits the tailrace safely and spill resumes.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.

Little Goose

Spring Spill Operations April 3 through June 20, 2010: 30% spill 24 hours per day with the spillway weir in service by April 4.

Changes in Operations for Research Purposes:

- Spring research operations: There will be no special spill operations for research in 2010. Juvenile fish survival after the initial year of evaluation with the new spillway weir installed in 2009 was 99.4% for juvenile yearling Chinook and 99.8% for juvenile steelhead. Established spill patterns as described in FPP Section 8 will be used in 2010.

Operational Considerations:

- Daily average flows in the lower Snake River of ≤32 kcfs can result in incompatible operations with Lower Monumental Dam and cause spill quantity fluctuations. Alternative Little Goose operations to resolve this issue are described in the Low Flow Operations section above and will be coordinated through the TMT.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.
- Turbine Unit 1 Operation: In 2010, operating range will be set within the GDACS program for Little Goose Dam to restrict Turbine Unit 1 operation to approximately the upper 25% of the 1% of best efficiency range (about 16-17.5 kcfs). This will ensure a strong current along the south shore to counter the strong eddy that forms in the tailrace during certain spill conditions. A strong south shore current in the tailrace is important for both adult fish passage and juvenile fish egress. If low flow conditions occur in the spring, the full ±1% of best efficiency range will be restored to minimize impacts on spill levels.

Lower Monumental

Spring Spill Operations April 3 through approximately June 20, 2010: Spill to the 115/120% TDG spill cap 24 hours per day.

Changes in Operations for Research Purposes:

- Spring research operations: There will be no special spill operations for research in 2010. The "bulk" spill pattern as described in FPP Section 7 will be used in 2010 based on previous years' study results which indicate higher dam survival using the "bulk" spill pattern compared to the "uniform" spill pattern.

Operational Considerations:

- Daily average flows of ≤32 kcfs can result in incompatible operations with Little Goose Dam and may cause spill quantity fluctuations.
- Transit of the juvenile fish barge across the Lower Monumental tailrace, then docking at and departing from the fish collection facility, may require spill level to be reduced due to safety concerns. The towboat captain may request that spill level be reduced or eliminated during transit. During juvenile fish loading operations, spill is typically reduced to 15 kcfs, but can be reduced further if necessary for safety reasons. Barge loading duration can be up to 3.5 hours. Because of the time needed to complete loading at Lower Monumental, the Little Goose Project personnel will notify the Lower Monumental personnel when the fish barge departs from Little Goose. This ensures that BPA scheduling is provided advance notice for spill control at Lower Monumental Dam. Reducing spill may cause the Lower Monumental pool to briefly operate outside of MOP conditions.
- Operating units within the 1% of best efficiency range translates to as much as 19 kcfs discharge for each of the 6 turbine units, for a maximum hydraulic capacity of approximately 114 kcfs. The expected spill cap is roughly 27 kcfs (but varies depending on total river discharge). Therefore, if total river discharge is greater than 141 kcfs the gas cap will be exceeded. Either lack of power load or unit outages can also cause forced spill above spill cap limits at higher total river discharges.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.

Ice Harbor

Spring Spill Operations April 3 through June 20, 2010: Spill will begin at 45 kcfs day/spill cap night on April 3 and continue until April 28. On April 28, spill will alternate between 45 kcfs day/spill cap night and 30% /30% with the RSW operating and continue through the spring season. Nighttime spill hours are 1800–0500.

Changes in Operations for Research Purposes:

- Spring research operations: There will be no special spill operations for research in 2010. Spill patterns as described in FPP Section 6 will be used in 2010.

Operational Considerations:

- Spill operation treatments may be rearranged within a week throughout the season. If rearrangement of treatment occurs, the total number of each spill level treatment for the spring season will not change. The flexibility to rearrange treatments during periods of higher power demand may alleviate the need to declare a power emergency.
- Powerhouse capacity at Ice Harbor is approximately 94 kcfs with all 6 units operating within the 1% of best efficiency range, while spill cap rates are about 100 kcfs. If total river flows exceed about 194 kcfs, TDG levels may exceed the water quality standards set by the States of Oregon and Washington.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.
- STSs will be installed by April 1. The normal juvenile bypass operation will be to route fish through the full flow bypass pipe, which has interrogation capability to monitor for PIT tags. From April 1 through July 31, juvenile fish will be sampled every 3 to 5 days to monitor fish condition and then bypassed to the river. Sampling activity may be terminated early should juvenile bypass fish numbers drop to the point where valid sampling is no longer feasible (100 fish of the most dominant species present are needed to properly assess fish condition). Sampling may also cease if the cumulative number of fish sampled for the season reach the permitted maximum.

McNary

Spring Spill Operations April 10 – approximately June 19, 2010: 40% spill 24 hours per day with the two spillway weirs operating. A spillway weir will be operated in both spillbay 19 and spillbay 20 for the period April 10 thru June 6. Both spillbay weirs will be removed from service by June 6 for the benefit of subyearling Chinook. This operational change has been coordinated through FFDRWG, FPOM, the Tribes, and NOAA. Temporary spill pattern changes to allow removal of the spillway weirs will occur, however spill will continue at 40% during the spillway weir removal process. Following removal of the spillway weirs, the spill pattern contained in Table MCN-10 in FPP section 5 will be used for the remainder of the spring.

Changes in Operations for Research Purposes:

- Spring research operations: There will be no special spill operations for research in 2010. Spill patterns as described in FPP Section 5 will be used in 2010. There will be special turbine operations for research in 2010. The special research operation will affect powerhouse units 4 and 5 which will be operated outside 1% efficiency to examine if adverse fish condition or descaling effects occur as a result. This evaluation is planned to occur on weekdays beginning on May 3 and continue through spring. The study has been coordinated through the SRWG process. Nighttime velocity reduction testing on adult lamprey may be initiated in mid- June in the Oregon shore ladder to test entrance and passage success.

Operational Considerations:

- Juvenile fish collected at McNary during the spring FOP implementation period will be bypassed to the river. The normal operation will be to bypass fish through the full flow bypass pipe, which has interrogation capability to monitor for PIT tags. Every other day, however, in order to sample fish for the Smolt Monitoring Program, fish will be routed through the separator, interrogated for PIT tags, and then bypassed to the river.
- All extended-length submersible bar screens (ESBSs) at McNary will be installed by April 15 as agreed to in consultation with FPOM, the Tribes, and NOAA. This is part of the Corps' consideration of lifting (or waiting to install) some turbine intake screens during periods of significant juvenile lamprey passage. Effects to both salmon and lamprey have been considered. Although there are some adverse impacts to migrating salmon from this delay in screen installation, regional sovereigns have considered this acceptable in balancing the needs of multiple species.
- During the periods when total river discharge exceeds approximately 320 kcfs, involuntary spill in excess of the States' TDG limits for fish passage may occur.
- In addition, low power demand may also necessitate involuntary spill at total river discharge of less than 320 kcfs.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.

John Day

Spring Spill Operations April 10 – June 30, 2010: 30% spill 24 hours per day prior to testing, then 30% spill vs. 40% spill 24 hours per day during the test. Spill levels will alternate in a random 4-day block with two-day treatments. Spill level changes will occur at 0600 hours.

Changes in Operations for Research Purposes:

- Spill duration for spillway weir testing: Testing in late April through early June. The dates of testing will be dependent on the size of fish, fish availability, and the number of treatments needed for testing. Final dates for testing will be coordinated through the SRWG.
- Spring research operations: A repeat of the 2009 spillway weir test is presented here for planning purposes; however details such as spill pattern and test timing may change. These changes will be coordinated through the SRWG and TMT. Two spillway weirs that pass approximately 10 kcfs spill each are installed in spill bays 18 and 19. Training spill patterns to support the spillway weir jets and provide good downstream egress for juvenile salmonids have been developed by modeling at ERDC and coordination with regional agencies. These are included in the FPP. Two spill levels will be tested to provide spill / spillway weir efficiency curves. These data will be used to design surface flow outlet and tailrace improvements at John Day Dam.

- Objectives of the biological test: The objectives of the study are to assess passage distribution and efficiency metrics, forebay retention, tailrace egress, and survival for yearling Chinook, and juvenile steelhead for two spill treatments.
- Spill pattern during biological test: Spill bays 18 and 19 have the spillway weirs installed, which are not easily opened and closed. Spill patterns for 30% and 40% spill have been developed at ERDC in coordination with regional agencies. These patterns are included in the FPP. From late April through early June, 30% spill versus 40% spill will be evaluated.

Operational Considerations:

- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.
- Unit outages and spillway outages may be required to repair hydrophones and other research equipment. These will be coordinated through FPOM and TMT as needed.

The Dalles

Spring Spill Operations April 10 – June 30, 2010: 40% spill 24 hours per day.

Changes in Operations for Research Purposes:

- Spill pattern during the biological test: New spill patterns developed for use with the recently completed spillwall and included in FPP section 3 will be used.

Operational Considerations:

- If total river discharge is between 90 and 150 kcfs, the spill percentage could range from 37.3 to 43.1 percent due to the new spill patterns developed for use with the newly completed spillwall.
- If the total river discharge is between 150 and 300 kcfs, the spill percentage could range from 38.1 to 42.1 percent due to the new spill patterns developed for use with the newly completed spillwall.
- If the total river discharge is between 300 and 420 kcfs, the spill percentage could range from 39.0 to 41.0.
- At no time is spill recommended on the south side of the spillway (Bays 14-22) as this creates a poor tailrace egress condition for spillway-passed fish.
- Spill bays 10, 11, 13, 16, 18, 19, and 23 are not operational due to wire rope, structural and concrete erosion concerns.
- The spill pattern in the FPP is based on a nominal Bonneville forebay elevation of 74 feet.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.

Bonneville

Spring Spill Operations April 10 – June 20, 2010: 100 kcfs spill 24 hours per day.

Changes in Operations for Research Purposes:

- Spill duration for testing: No special spill operations are required for biological tests in 2010. Current FPP spill patterns included in FPP section 2 will be used.

Operational Considerations:

- Minimum spill discharge rate is 75 kcfs however, under extreme low flow conditions lower spill levels may be considered and coordinated through the TMT. This is to provide acceptable juvenile fish egress conditions in the tailrace.
- At total spring flows less than about 135 kcfs, spill will be less than 100 kcfs to maintain minimum powerhouse generation of 30 kcfs plus fish ladder and facility spill (e.g. second powerhouse corner collector, first powerhouse sluiceway).
- The TMT will consider the possible effects of TDG on emerging chum salmon downstream of Bonneville Dam. The TMT may request special operations such as flow increases or spill reductions to protect ESA-listed fish.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.
- Actual spill levels at Bonneville Dam may range from 1 to 3 kcfs lower or higher than specified in Table 2. A number of factors influence this including hydraulic efficiency, exact gate opening calibration, spillway gate hoist cable stretch due to temperature changes, and forebay elevation (a higher forebay results in a greater volume of spill since more water can pass under the spill gate).
- The second powerhouse Corner Collector (5 kcfs discharge) will operate from the morning of April 10 through the remainder of the spring season as coordinated at the March 11 FPOM meeting.

TRANSPORT, LATENT MORTALITY, AND AVIAN RESEARCH

Seasonal Effects of Transport

A study will be conducted to determine seasonal effects of transporting fish from the Snake River to optimize a transportation strategy. At Lower Granite, fish will be collected for this study starting on April 5, with marking beginning on April 6, 2010. Depending on the number of fish available, fish will be collected 1-2 days with tagging occurring on the day following collection. A barge will leave each Thursday morning with all fish collected during the previous 1-3 days. By barging all fish (minus the in-river group) during 1 to 3 days of collection, barge densities will be maintained at a level similar to what would occur under normal transport operations that time of year. This pattern will occur in the weeks preceding general transportation and will be incorporated into general transportation once that operation begins. The desired transported sample

size is 6,000 wild Chinook and 4,000 - 6,000 wild steelhead weekly for approximately eight weeks.

Latent Mortality

A study will be conducted to evaluate latent mortality associated with passage through Snake River dams. The goal of this study is to determine whether migration through Snake River dams and reservoirs causes extra mortality in Snake River yearling (spring/summer) Chinook salmon smolts. Specifically, the study will determine if life-cycle survival downstream from McNary Dam is significantly higher for yearling hatchery Chinook salmon released into the Ice Harbor Dam tailrace than for counterparts which must pass three additional dams and reservoirs after release into the Lower Granite Dam tailrace. Fish will be collected at Lower Granite Dam beginning April 20, 2010 with the goal of tagging approximately 120,000 smolts, about 2/3 of which will be released into the tailrace of Lower Granite Dam, and 1/3 transported by truck and released in the tailrace of Ice Harbor Dam.

EMERGENCY PROTOCOLS

The Corps and the Bureau of Reclamation will operate the projects in emergency situations in accordance with the WMP Emergency Protocol (WMP Appendix 1). This protocol identifies the process the Action Agencies will use in the event of an emergency concerning the operation of FCRPS that impacts planned fish protection measures. The most recent version of the Emergency Protocols is located at: http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/2010/final/emerproto

COORDINATION

To make adjustments in response to changes in conditions, the Corps will utilize the existing regional coordination committees. Changes in spill rates when flow conditions are higher or lower than anticipated will be coordinated through the TMT. This could include potential issues and adjustments to the juvenile fish transportation program. Spill patterns and biological testing protocols that have not been coordinated to date will be finalized through the Corps' AFEP subcommittees, which include the SRWG, FFDRWG, and FPOM.

REPORTING

The Corps will provide periodic in-season updates to TMT members on the implementation of 2010 fish passage operations. The updates will include the following information:

- the hourly flow through the powerhouse;
- the hourly flow over the spillway compared to the spill target for that hour; and,
- the resultant 12-hour average TDG for the tailwater at each project and for the next project's forebay downstream.

The updates will also provide information on substantial issues that arise as a result of the spill program (e.g. Little Goose adult passage issues in 2005 and 2007), and will address any emergency situations that arise.

The Corps will continue to provide the following data to the public regarding project flow, spill rate, TDG level, and water temperature.

- Flow and spill quantity data for the lower Snake and Columbia River dams are posted to the following website every hour: http://www.nwd-wc.usace.army.mil/report/projdata.htm
- Water Quality: TDG and water temperature data are posted to the following website every six hours: http://www.nwd-wc.usace.army.mil/report/total.html. These data are received via satellite from fixed monitoring sites in the Columbia and Snake rivers every six hours, and placed on a Corps public website upon receipt. Using the hourly TDG readings for each station in the lower Snake and Columbia rivers, the Corps will calculate both the highest and highest consecutive 12-hour average TDG levels daily for each station. These averages are reported at: http://www.nwd-wc.usace.army.mil/ftppub/water_quality/12hr/html/

CENWD-PDD June 2010

2010 Summer Fish Operations Plan

INTRODUCTION

The 2010 Summer Fish Operations Plan (FOP) describes the U.S. Army Corps of Engineers' (Corps) planned operations for fish passage at its mainstem Federal Columbia River Power System (FCRPS) dams during the 2010 summer fish migration season, generally June through August. The Action Agencies are committed to the summer spill measures and achieving mainstem FCPRS project hydro performance standards contained in the 2008 NOAA Fisheries Biological Opinion (BiOp) and Supplemental BiOp, as supported by the BiOp analyses. The Action Agencies are also interested in expeditious resolution of the case challenging these opinions, therefore for 2010, the agencies support adoption of the project operations contained in the Order for 2009 Summer Spill Operations. The 2010 Summer FOP adopts project operations in the Order for 2009 Summer Spill Operations with the exception of operational adjustments to conduct essential research at Bonneville Dam.

The 2010 Summer FOP also provides for adaptive management and is consistent with the 2008 BiOp, the 2010 Supplemental BiOp, and the Corps' Record of Consultation and Statement of Decision Documents (2008 and 2010 Amended ROCASOD) adopting the project operations contained in the 2008 BiOp and 2010 Supplemental BiOp. As in the 2009 Summer FOP, operations described herein may be adjusted to address in-season developments through discussion and coordination with regional sovereigns. Other FCRPS water management actions and project operations not specifically addressed in this document shall be consistent with the 2008 and 2010 Supplemental BiOp and other guiding operative documents including the 2010 Water Management Plan (WMP), seasonal WMP updates, and the 2010 Fish Passage Plan (FPP).

The following sections describe factors that influence management of fish operations during various runoff conditions, including: total dissolved gas (TDG) management, spillway operations, minimum generation requirements, operations under low flow conditions, navigation safety, juvenile fish transportation operations, specified summer operations for fish at each mainstem project, protocols for fish protection measures related to operational emergencies, coordination with regional entities, and monthly reporting.

GENERAL CONSIDERATIONS FOR FISH OPERATIONS

For planning purposes, the Corps' 2010 Summer FOP assumes average runoff conditions. However, because actual runoff conditions vary in timing and shape and may be higher or lower than average adjustments in fish transportation and/or spill operations (kcfs discharge levels, spill percentages, or spill caps) will be adaptively managed in-season.

These in-season changes will be coordinated through the Technical Management Team (TMT) and other appropriate regional forums, to avoid or minimize poor juvenile or adult fish passage conditions, navigation safety concerns, or to accommodate powerhouse and/or transmission system constraints. Actual spill levels may be adaptively managed to accommodate fish research or other conditions and will be coordinated through the TMT and other appropriate regional forums.

Management of Spill for Fish Passage

The Corps will manage spill for fish passage to avoid exceeding 120% TDG in project tailraces, and 115% TDG in the forebay of the next project downstream.[1] These levels are referred to as "gas caps". The project maximum spill discharge level that meets, but does not exceed the gas cap, is referred to as the spill cap. Gas caps are constant, whereas spill caps may vary daily depending on flow, spill pattern, temperature, and other environmental conditions.

As noted above, the spill levels presented below in Table 2 are planned spill operations and assume average runoff conditions; however, adjustments to these spill rates may be necessary. Reasons for these adjustments may include:

1. Low runoff conditions that may require adjustments in spill level while still meeting project minimum generation requirements.
2. High runoff conditions where flows exceed the powerhouse hydraulic capacity with the specified spill rates.
3. Navigation safety concerns.
4. Generation unit outages that reduce powerhouse capacity.
5. Power system or other emergencies that reduces powerhouse discharge.
6. Lack of power demand resulting in an increase of spill level.

The Corps' Reservoir Control Center (RCC) is responsible for daily management of spill operations responsive to changing TDG conditions. In order to manage gas cap spill levels consistent with the states' TDG saturation limits, the RCC establishes the spill caps for each project on the lower Columbia and Snake rivers on a daily basis throughout the fish passage season. These spill caps are set so that resultant TDG percent saturation levels are not expected to exceed the 120%/115% TDG limits measured as the average of the highest 12 hourly readings each day.

Within any given day, some hours of measured TDG levels may be higher or lower than the gas caps due to changing environmental conditions (wind, air temperature, etc.). The process of establishing daily spill caps entails reviewing existing hourly data at each dam (including flow, spill, temperature, and TDG levels) and taking into consideration a number of forecast conditions (including total river discharge, powerhouse discharge, wind and temperature forecast, etc.). These data are used as input variables into the

[1] In February 2009, the State of Oregon modified its waiver for 2009 to remove the 115% forebay TDG limit. However, the Corps will continue to manage to 120% and 115% in 2010, consistent with 2009 court ordered operations.

System TDG (SYSTDG) model. The SYSTDG model estimates TDG levels expected several days into the future and is a tool integral to daily decision-making when establishing spill caps at individual dams. Spill caps set by RCC and contained in the daily spill priority list will be met at the projects using the individual project spill pattern(s) contained in the FPP Sections 2 through 9, which most closely correspond to the specified spill level (i.e. may be slightly over or under the specified spill discharge or percent value). During periods when river discharge is greater than project powerhouse hydraulic capacity or a lack of power load results in an increase in the spill level, the Corps will attempt to minimize TDG on a system-wide basis. In this case, spill caps are also developed for 125%, 130%, or 135% saturation as a means of minimizing TDG throughout the system.

The Corps will transition to summer spill operations at 0001 hours, or shortly after midnight, at each of the projects on the start dates specified in the project sections below. Spill caps will be established at the specified levels and will continue unless conditions require changing to maintain TDG within the upper limits of 120% in the tailwater of a dam and 115% in the forebay of the next project downstream (and at Camas/Washougal except during research operations at Bonneville Dam from June 16 - July 20). Operations to manage TDG will continue to be coordinated through the TMT.

Spillway Operations

The Action Agencies will meet the specified spill levels to the extent feasible; however, actual hourly spill quantities at dams will be slightly greater or less than specified in Table 2 below. Actual spill levels depend on the precision of spill gate settings, flow variations in real time, varying project head (the elevation difference between a project's forebay and tailwater), automatic load following, and other factors.

Operational Considerations:

- Spill discharge levels: Project spill levels listed in Table 2 coincide with specific gate settings in the FPP project spill pattern tables. Due to limits in the precision of spill gates and control devices, short term flow variations, and head changes, it is not always possible to discharge the exact spill levels stated in Table 2, or as stated in RCC spill requests (teletypes) to projects that call for discrete spill discharges. Therefore, spillway gates are opened to the gate settings identified in the FPP project spill pattern tables to provide spill discharge levels that are the closest to the prescribed spill discharge levels.

- Spill percentages: Spill percentages are considered target spill levels. The project control room operator and BPA duty scheduler calculate spill levels to attempt to be within ±1% of the target percentage for the following hour (or more than ±1% at Little Goose Dam when river discharge is less than approximately 40 kcfs; or up to ±1.6% at The Dalles Dam). Prescribed or specified percentages in Table 2 may not always be attained due to low discharge conditions, periods of minimum generation, spill cap limitations, temporary spill curtailment for navigation safety, and other

unavoidable circumstances. Operators and schedulers review the percentages achieved during the day and will attempt to adjust spill rates in later hours if necessary, with the objective of ending the day with a daily average spill percentage that achieves the specified spill percentage.

Minimum Generation

The Corps has identified minimum generation flow values derived from actual generation records when turbines were operating within ±1% of best efficiency (Table 1). Values stated in Table 1 are approximations that account for varying head or other small adjustments in turbine unit operation that may result in variations from the reported minimum generation flow and spill amount. Conditions that may result in minor variations include:

1. Varying pool elevation: as reservoirs fluctuate within the operating range, flow rates through the generating unit change.
2. Generating unit governor "dead band": the governor controls the number of megawatts the unit should generate, but cannot precisely control a unit discharge; variations may be 1-2% of generation.
3. System disturbances: once a generator is online and connected to the grid, it responds to changes in system voltage and frequency. These changes may cause the unit to increase discharge and generation slightly within an hour. Individual units operate differently from each other and often have unit specific constraints.
4. Generation control systems regulate megawatt (MW) generation only; not discharge through individual turbine units.

All of the lower Snake River powerhouses may be required to keep one generating unit on line at all times for power system reliability under low river discharge conditions, which may result in a reduction of spill at that project. All of the Snake River projects have two “families” of turbines with slightly different capacities – small and large. In most cases during low flow conditions, one of the smaller turbine units (with reduced generation and flow capabilities) will be online. The smaller turbine units are generally numbered 1–3 and are the first priority for operation during the fish passage season. If smaller turbine units are unavailable, larger units may be used instead. At Little Goose, turbine unit 1, the first priority unit during fish passage, typically operates near the upper end of the ±1% of best efficiency range for the purpose of providing tailrace conditions that are favorable for juvenile and adult fish passage.

During low river discharge events, generally the operating unit runs at the lower end of the ±1% of best efficiency range. However, at Lower Monumental, turbine unit 1, which is the first priority unit during fish passage, has welded blades and consequently cannot operate at the low end of the design range. Ice Harbor turbine units cannot be operated at the lower end of the ±1% of best efficiency range. At generation levels near the lower end of the ±1% of best efficiency range, excessive cavitation occurs, which can damage the turbine runner and also be detrimental to fish. Therefore, Ice Harbor turbine units will operate at a generation level somewhat higher than the lower ±1% limit.

Additionally, Ice Harbor unit 2 has welded blades affecting minimum generation for that unit. Minimum generation flow ranges at McNary, John Day, and The Dalles are 50-60 kcfs; and 30-40 kcfs at Bonneville as shown in Table 1.

Table 1.— Minimum generation ranges for turbine units at the four lower Snake and four lower Columbia River dams.

Project	Turbine Units	Minimum Generation (kcfs)
Lower Granite	1-3	11.3-13.1
	4-6	13.5-14.5
Little Goose	1-3	11.3-13.1
	4-6	13.5-14.5
Lower Monumental	1	16.5-19.5
	2-3	11.3-13.1
	4-6	13.5-14.5
Ice Harbor	1, 3-6	8.5-10.3
	2	11.3-13.1
McNary	N/A	50-60
John Day	N/A	50-60
The Dalles	N/A	50-60
Bonneville	N/A	30-40

Low Flow Operations

Low flow operations at lower Snake River projects are triggered when inflow is not sufficient to meet both minimum generation requirements and planned spill levels in Table 2. In these situations, Snake River projects will operate one turbine unit at minimum generation and spill the remainder of flow coming into the project. Columbia River projects will also operate at minimum generation and pass remaining inflow as spill down to minimum spill levels under low flow conditions. As flows transition from higher flows to low flows, there may be situations when flows recede at a higher rate than forecasted. In addition, inflows provided by non-Federal projects upstream are often variable and uncertain. The combination of these factors may result in instances where unanticipated changes to inflow result in forebay elevations dropping to the low end of the Minimum Operating Pool (MOP). Consequently, maintaining minimum generation and the target spill may not be possible on every hour since these projects have limited operating flexibility.

During low flow conditions when the navigation lock is being emptied at some projects, the total spill volume remains constant, but the spill reported as a percent of total flow may be temporarily reduced below the target spill percentage. This occurs because the volume of water needed to empty the navigation lock during periods of low flow is a greater percentage of the total flow than when river flows are higher.

At Little Goose Dam, when daily average flows in the lower Snake River are ≤32 kcfs as a daily average, achieving 30% spill requires switching turbine operations between operating 2 units at the low end of the ±1% of best efficiency range to operating one unit at the high end of the ±1% of best efficiency range. This operation is incompatible with the more constant discharge upstream at Lower Granite Dam. It is also often difficult to achieve the FOP prescribed spill level downstream at Lower Monumental Dam and maintain MOP operations. In 2009, through coordination with TMT during low flow periods, Little Goose spill operations changed from 30% to a flat spill level of approximately 7-11 kcfs to smooth out Little Goose discharges, meet Lower Monumental spill levels, and maintain the MOP operating range at Little Goose. For 2010, the Fish Passage Operations and Maintenance Team (FPOM) recommended removing the spillway weir from service for the season when river discharge is forecasted to drop below 32 kcfs for three days. Weir removal allows allow finer control of spill discharge during periods of low river discharge. If necessary in 2010, additional operational adjustments at Little Goose may be implemented during low flow periods after coordination with FPOM/TMT.

Operations during Rapid Load Changes

Project operations during hours in which load and/or intermittent generation changes rapidly may result in not meeting planned hourly spill level because projects must be available to respond to within-hour load variability to satisfy North American Electric Reliability Council (NERC) reserve requirements ("on response"). This usually occurs at McNary, John Day and The Dalles dams. In addition to within-hour load variability, projects on response must be able to respond to within hour changes that result from intermittent generation (such as wind generation). During periods of rapidly changing loads and intermittent generation, projects on response may have significant changes in turbine discharge within the hour while the spill quantity remains the same within the hour. Under normal conditions, within-hour load changes occur mostly on hours immediately preceding and after the peak load hours, however, within-hour changes in intermittent generation can occur at any hour of the day. Due to the high variability of within-hour load and intermittent generation, these load swing hours may have a greater instance of reporting actual spill percentages that vary more than the ±1% requirement than other hours.

Turbine Unit Testing around Maintenance Outages

Turbine units may be operationally tested for up to 30 minutes by running the unit at speed no load and various loads within the ±1% of best efficiency range to allow pre-maintenance measurements and testing and to allow all fish to move through the unit. Units may be operationally tested after maintenance or repair efforts but before a unit comes out of a maintenance or forced outage status. Operational testing may consist of running the unit for up to 30 minutes before it is returned to operational status. Operational testing of a unit under maintenance is in addition to a unit in run status (e.g. minimum generation) required for power plant reliability. Operational testing may deviate from unit operating priorities and may use water that would otherwise be used for

spill if the running unit for reliability is at the bottom of the ±1% of best efficiency range. Water will be used from the powerhouse allocation if possible, and water diverted from spill for operational testing will be minimized. The Corps will coordinate this testing with the region through the FPOM.

Navigation Safety

Short-term adjustments in spill may be required for navigation safety, primarily at the lower Snake projects, but may also be necessary at the lower Columbia projects. This may include changes in spill patterns, reductions in spill discharge rates, or short-term spill stoppages. In addition, unsteady flow at Little Goose due to switching between operating one and two units during low flow conditions may impact that project's reservoir elevation and cause inadequate navigation depths at the downstream entrance to the Lower Granite navigation lock. Therefore, adjustments to pool elevation in the Little Goose pool of up to 1.0 ft. above the MOP operating range may be necessary to accommodate safe entrance to the navigation lock at Lower Granite Dam during periods of low flow (approximately 50 kcfs or less) and will be coordinated in TMT. These adjustments may be necessary for both commercial tows and fish barges.

JUVENILE FISH TRANSPORTATION PROGRAM OPERATIONS

The following describes the juvenile fish transportation program under all runoff conditions and is consistent with the 2009 Summer FOP transport operations. The lower Snake River projects are described first, followed by McNary project operations. Detailed descriptions of project and transport facility operations, including the transition from barges to trucks when fish numbers decrease in the summer, are contained in FPP Appendix B.

Lower Snake River Dams - Operation and Timing

The 2010 Spring FOP provides information about the initiation of transport at the lower Snake River collector projects. Summer transport operations at the lower Snake River collector projects will continue as specified in the Order for 2009 Summer Spill Operations. Starting on or about August 15, fish will be transported by truck, dependant on numbers of subyearling Chinook collected. Transport operations will be carried out concurrent with FOP spill operations at each project and in accordance with all relevant FPP operating criteria. Fish transportation operations for the lower Snake River collector projects are described in FPP Appendix B.

Fish transportation operations are expected to continue through approximately October 31 at Lower Granite and Little Goose dams, and through September 30 at Lower Monumental Dam. Transportation operations may be adjusted due to research, conditions at the collection facilities, or through the adaptive management process to better match juvenile outmigration timing or achieve/maintain performance standards.

McNary Dam - Operation and Timing

Transportation will be initiated at McNary Dam between July 15–30 per the 2008 BiOp (RPA 30, Table 4) and in coordination with NOAA Fisheries and the TMT. Fish will be transported from McNary Dam by barge through August 16, then transported by truck every other day. All fish collected will be transported except those marked for in-river studies. Fish are expected to be transported through September 30. The presence of factors such as excess shad, algae or bryozoans that can clog screens and flumes may result in discontinuing transport operations at McNary Dam before September 30. Detailed criteria for McNary transport are contained in the FPP, Appendix B.

Transportation operations may be adjusted for research purposes, due to conditions at the collection facilities, or as a result of the adaptive management process (to better match juvenile outmigration timing and/or to achieve or maintain performance standards). If new information indicates that modifying (or eliminating) transportation operations at McNary Dam is warranted, adaptive management will be used to make appropriate adjustments through coordination with the FPOM/TMT.

SUMMER SPILL OPERATIONS

Lower Snake River Projects

Summer spill will begin on June 21 at Lower Granite, Little Goose, Lower Monumental and Ice Harbor dams. Summer operations will continue 2009 Court ordered spill through August 31 at all four lower Snake River projects. Summer spill levels are shown in Table 2.

Lower Columbia River Projects

Summer spill will begin July 1 at John Day and The Dalles dams, June 20 at McNary Dam, and June 16 at Bonneville Dam. Summer spill will occur through August 31 at all four Columbia River projects. Summer spill levels are shown in Table 2.

PROJECT SUMMER OPERATIONS

The following sections describe 2010 summer spill operations for each project. Included in the descriptions are planned research activities intended to meet reasonable and prudent alternative actions identified in the 2008 and 2010 Supplemental BiOp. The Corps, regional fishery agencies, and Tribes are interested in the continuation of project research studies under the Corps' Anadromous Fish Evaluation Program (AFEP). These studies have been evaluated through the annual AFEP review process with the regional fishery agencies and Tribes, with the study designs being finalized prior to initiation in 2010. The studies are intended to provide further information on project survival that will help inform the region in making decisions on future operation and configuration actions to improve fish passage and survival and meet BiOp performance standards at the lower Snake and Columbia River dams.

Table 2.— Summary of 2010 summer spill levels at lower Snake and Columbia River projects.[2]

Project	Planned 2010 Summer Spill Operations (Day/Night)	Comments
Lower Granite	18 kcfs/18 kcfs	Same as 2009
Little Goose	30%/30%	Same as 2009
Lower Monumental	17 kcfs/17 kcfs	Same as 2009
Ice Harbor	**June 21-July 13:** 30%/30% vs. 45 kcfs/Gas Cap **July 13-August 31:** 45 kcfs/Gas Cap (approximate Gas Cap range: 75-95 kcfs)	Same as 2009
McNary	50%/50%	Same as 2009 (except without spillway weirs)
John Day	**July 1-July 20:** 30%/30% vs. 40%/40% **July 20-August 31:** 30%/30%	Same as 2009
The Dalles	40%/40%	Same as 2009
Bonneville	**June 16-July 20:** 85 kcfs/121 kcfs vs. 95 kcfs/95 kcfs **July 21-August 31:** 75 kcfs/Gas Cap	Research operation from June 16-July 20; same as 2009 from July 21-August 31

Lower Granite

Summer Spill Operations June 21 – August 31: 18 kcfs 24 hours per day.

Changes in Operations for Research Purposes:

- Summer research operations: There will be no special spill operations for research in 2010. Established spill patterns as described in FPP Section 9 will be used in 2010.

Operational Considerations:

- Lack of power load or unexpected unit outages could cause involuntary spill at higher total river discharges that could result in exceeding the gas cap limits.
- During periods when involuntary spill occurs, there may be instances when certain spill levels create hydraulic conditions that are unsafe for fish barges crossing the tailrace and/or while moored at fish loading facilities. If such conditions occur, spill

[2] Table 2 displays in summary form the planned summer spill operations. More specific detail governing project operations is included in project specific sections.

may be reduced temporarily when fish transport barges approach or leave the barge dock or are moored at loading facilities. If conditions warrant a spill reduction, the MOP elevation range at Lower Granite will be exceeded temporarily to enable the barge to exit the tailrace safely.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.

Little Goose

Summer Spill Operations June 21 – August 31: 30% spill 24 hours per day.

Changes in Operations for Research Purposes:

- Summer research operations: There will be no special spill operations for research in 2010. Established spill patterns as described in FPP Section 8 will be used in 2010.

Operational Considerations:

- Daily average flows in the lower Snake River of ≤32 kcfs can result in discharge rates from Little Goose Dam that are incompatible with operations and may cause spill quantity fluctuations at Lower Monumental Dam. Alternative Little Goose operations to resolve this issue are described in the Low Flow Operations section above and will be coordinated through the FPOM/TMT.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.
- Turbine Unit 1 Operation: In 2010, operating range will be set within the GDACS program for Little Goose Dam to restrict Turbine Unit 1 operation to approximately the upper 25% of the 1% of best efficiency range (about 16-17.5 kcfs). If low flow conditions occur in the summer, the full ±1% of best efficiency range may be restored to minimize impact on spill levels.

Lower Monumental

Summer Spill Operations Approximately June 21 – August 31: Spill 17 kcfs 24 hours per day.

Changes in Operations for Research Purposes:

- Summer research operations: There will be no special spill operations for research in 2010. Spill patterns as described in FPP Section 7 will be used in 2010.

Operational Considerations:

- Daily average flows of ≤32 kcfs can result in incompatible operations with Little Goose Dam and may cause spill quantity fluctuations.

- Transit of the juvenile fish barge across the Lower Monumental tailrace, then docking at and departing from the fish collection facility, may require spill level to be reduced due to safety concerns. The towboat captain may request that spill level be reduced or eliminated during transit. During juvenile fish loading operations, spill is typically reduced to 15 kcfs, but can be reduced further if necessary for safety reasons. Barge loading duration can be up to 3.5 hours. Because of the time needed to complete loading at Lower Monumental, the Little Goose Project personnel will notify the Lower Monumental personnel when the fish barge departs from Little Goose. This ensures that BPA scheduling is provided advance notice for spill control at Lower Monumental Dam. Reducing spill may cause the Lower Monumental pool to briefly operate outside of MOP conditions.
- Unit outages may occur for required or emergency unscheduled maintenance activities described in FPP Appendix A. Maintenance dates are subject to change.

Ice Harbor

Summer Spill Operations June 21 – August 31: Spill operations will continue from spring at 30% 24 hours per day vs. 45 kcfs day/Gas Cap night until July 13 at 0500 hours, then 45 kcfs day/Gas Cap night through August 31.

Changes in Operations for Research Purposes:

- Summer research operations: There will be no special spill operations for research in 2010. Spill patterns as described in FPP Section 6 will be used in 2010.

Operational Considerations:

- Spill operation treatments may be rearranged within a week throughout the season. If rearrangement of treatment occurs, the total number of each spill level treatment for the spring season will not change. The flexibility to rearrange treatments during periods of higher power demand may alleviate the need to declare a power emergency.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change in coordination with FPOM or TMT.

McNary

Summer Spill Operations June 20 – August 31: 50% spill 24 hours per day without spillway weirs, using the spill patterns contained in Table MCN-10 in FPP section 5.

Changes in Operations for Research Purposes:

Summer research operations: There will be no special spill operations for research in 2010. There will be special turbine operations for research in 2010. The special research operation will affect powerhouse units 4, 5, and 6 which will be operated outside 1%

efficiency to examine if adverse fish condition or descaling effects occur as a result. The study has been coordinated through the Studies Review Work Group (SRWG) process. Nighttime velocity reduction testing on adult lamprey may be initiated in mid-June in the Oregon shore ladder to test entrance and passage success.

Operational Considerations:

- During the periods when total river discharge exceeds approximately 320 kcfs, involuntary spill in excess of the States' TDG limits for fish passage may occur.
- Spill will be curtailed as needed to allow safe operation of fish transportation barges near collection facilities downstream of the project.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.

John Day

Summer Spill Operations July 1 – August 31: Spill operations will continue from spring at 30% vs. 40% spill 24 hours per day and continue through the test period until approximately July 20. During testing, spill levels will alternate in a random four-day block with two-day treatments (30% or 40% spill). Spill treatment changes will occur at 0600 hours. Once testing concludes, 30% spill 24 hours per day will continue through August 31. Spill patterns contained in FPP section 4 will be used during summer.

Changes in Operations for Research Purposes:

- Spill duration for testing: Approximately early June to July 20 (carrying over from spring operations). Dates of testing will be dependent on the fish size, fish availability, and the number of treatments needed for acquiring a statistically valid number of replicates. Final dates for testing will be coordinated through the SRWG. Summer testing will begin prior to summer operations however, the same spill levels implemented in spring (30% vs. 40%) will continue through summer testing.
- Summer research operations: A repeat of the 2009 spillway weir test is presented here for planning purposes; however details such as spill pattern and test timing may change. These changes will be coordinated through the SRWG and TMT. Two spillway weirs that pass approximately 10 kcfs spill each are installed in spill bays 18 and 19.
- Objectives of the biological test: The objectives of the study are to assess passage distribution and efficiency metrics, forebay retention, tailrace egress, and survival for subyearling Chinook under two spill treatments.
- Spill pattern(s) during biological test: Spill patterns for 30% and 40% spill have been developed at ERDC in coordination with regional agencies. These patterns are included in the FPP section 4.

Operational Considerations:

- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.
- Unit outages and spillway outages may be required to repair hydrophones and other research equipment. These will be coordinated through FPOM and TMT as needed.

The Dalles

Summer Spill Operations July 1 – August 31: 40% spill 24 hours per day.

Changes in Operations for Research Purposes:

- Spill pattern during the biological test: New spill patterns developed for use with the recently completed spillwall and included in FPP section 3 will be used.

Operational Considerations:

- If total river discharge is between 90 and 150 kcfs, spill percentage could range from 38.6 to 41.4 percent.
- If total river discharge is between 150 and 300 kcfs, the spill percentage could range from 38.9 to 41.2 percent.
- If total river discharge is between 300 and 420 kcfs, the spill percentage could range from 38.4 to 41.0 percent.
- At no time is spill recommended on the south side of the spillway (Bays 14-22) as this creates a poor tailrace egress condition for spillway-passed fish.
- Spill bays 10, 11, 13, 16, 18, 19, and 23 are not operational due to wire rope, structural and concrete erosion concerns.
- The spill pattern in FPP section 3 is based on a nominal Bonneville forebay elevation of 74 feet.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.
- If river flow drops below about 90 kcfs then spill may need to drop below 40% spill in order to maintain station service and power system needs.

Bonneville

Summer Spill Operations June 16 – August 31: Summer research operation consisting of a two treatment spill test of 85 kcfs/121 kcfs vs. 95kcfs/95 kcfs. The research operation will begin at 0430 hours on June 16 and continue through July 20. This summer research operation begins earlier than the spring to summer transition dates identified in the 2010 Spring FOP, however the operation and transition date has been fully coordinated with and has the full support of regional sovereigns. During testing, spill levels will alternate in a random four-day block with two-day treatments. Spill treatment changes will occur according the daytime spill schedule contained in Table BON-5 in FPP section 2. Following the research operation, a 75 kcfs/Gas Cap operation

will begin on July 21 and continue through August 31. It takes approximately 10 minutes to change between day and night summer spill levels.

Changes in Operations for Research Purposes:

- Spill duration for testing: Approximately June 16 – July 20.
- Summer research operations: 85 kcfs/121 kcfs vs. 95kcfs/95 kcfs (unconstrained by the Camas/Washougal fixed monitoring TDG station).
- Objectives of the biological test: The objectives of the study are to assess passage distribution and efficiency metrics, forebay retention, tailrace egress, and survival for subyearling Chinook under two spill treatments.
- Spill pattern for summer operations: Spill patterns in FPP section 2 will be used.

Operational Considerations:

- Turbine unit and corner collector outages may be required to repair hydrophones and other research equipment. These will be coordinated through FPOM and TMT.
- The current minimum spill level is 50 kcfs per prior Fish Operations Plans and Fish Passage Plans. In view of the best biological information, alternative minimum spill operations are currently being examined. If an alternative minimum spill operation is developed, changes will be coordinated through regional processes.
- Actual kcfs spill levels at Bonneville Dam may range up to 3 kcfs lower or higher than levels specified in Table 2. A number of factors influence this including hydraulic efficiency, exact gate opening calibration, spillway gate hoist cable stretch due to temperature changes, and forebay elevation (a higher forebay results in a greater volume of spill since more water can pass under the spill gate).
- The second powerhouse corner collector (5 kcfs discharge) will operate until the afternoon of August 31.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.

COORDINATION

To make adjustments in response to changes in conditions, the Corps will utilize the existing regional coordination committees. Changes in spill rates when flow conditions are higher or lower than anticipated will be coordinated through the TMT. This could include potential issues and adjustments to the juvenile fish transportation program. Spill patterns and biological testing protocols that have not been coordinated to date will be finalized through the Corps' AFEP subcommittees, which include the SRWG, FPOM, and FFDRWG.

REPORTING

The Corps will provide periodic in-season updates to TMT members on the implementation of 2010 fish passage operations. The updates will include the following information:

- the hourly flow through the powerhouse
- the hourly flow over the spillway compared to the spill target for that hour
- the resultant 12-hour average TDG for the tailwater at each project and for the next project's forebay downstream

The updates will also provide information on substantial issues that arise as a result of the spill program (e.g. Little Goose adult passage issues in 2005 and 2007), and will address any emergency situations that arise. The Corps will continue to provide the following data to the public regarding project flow, spill rate, TDG level, and water temperature.

- Flow and spill quantity data for the lower Snake and Columbia River dams are posted to the following website every hour: http://www.nwd-wc.usace.army.mil/report/projdata.htm
- Water Quality: TDG and water temperature data are posted to the following website every six hours: http://www.nwd-wc.usace.army.mil/report/total.html These data are received via satellite from fixed monitoring sites in the Columbia and Snake rivers every six hours, and placed on a Corps public website upon receipt. Using the hourly TDG readings for each station in the lower Snake and Columbia rivers, the Corps will calculate both the twelve highest hourly (OR method) and highest consecutive twelve-hour average (WA method) TDG levels daily for each station. These averages are reported at:
  http://www.nwd-wc.usace.army.mil/ftppub/water_quality/12hr/html/