

April 2009

**APPENDIX E**

**OPERATIONS RELATED TO PROJECT SPILL FOR FISH PASSAGE**

**2009 FISH OPERATIONS PLAN  
(spring)**

## **2009 Spring Fish Operations Plan**

### **BACKGROUND**

The 2009 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 2009 spring fish migration season, generally April through June. The 2009 spring spill operations are consistent with the 2008 Court ordered spring spill operations except for two operational changes. At John Day Dam, prior to the spillway weir test, there will be 30%/30% day/night spill instead of the 0%/60% spill that occurred in 2008. Otherwise, 2009 spring spill operations will remain the same as in spring 2008. At Little Goose Dam, in order to test the newly installed spillway weir, spill will be maintained at a consistent 30%/30% day/night for the entire duration of 2009 spring spill operations. The Corps will not spill for 14 nights to the total dissolved gas (TDG) cap as this would interfere with testing the new spillway weir.

The 2009 Spring FOP is consistent with the adaptive management provisions in the 2008 NOAA Fisheries FCRPS Biological Opinion (2008 BiOp) and the Corps' Record of Consultation and Statement of Decision (ROCASOD) adopting the project operations contained in and the Columbia Basin Fish Accords (Accords).

As in 2008, the 2009 Spring FOP incorporates planned operational adjustments necessary to perform essential research, and to accommodate the installation or adjustment of surface bypass structures or other features for the 2009 spring migration season. The FCRPS water management and project operations not specifically addressed in this 2009 Spring FOP also are consistent with the 2008 BiOp, and other operative documents including the 2009 Water Management Plan (WMP), seasonal WMP updates, and the 2009 Fish Passage Plan (FPP). As in 2008, operations may be adjusted through coordination with regional sovereigns.

The following sections describe: factors that influence management of fish operations during various runoff conditions, including TDG management, spillway operations, and minimum generation; specific spring operations for fish passage at each mainstem project; the juvenile fish transportation program operations; protocols for emergencies; coordination with the region; and, monthly reporting.

## **GENERAL CONSIDERATIONS FOR FISH OPERATIONS**

For planning purposes, the Corps' 2009 Spring FOP assumes "average" run-off conditions as summarized in Table 1 below. However, because actual run-off conditions vary in timing and shape and may be higher or lower than average, adjustments in spill levels (kcfs discharge rates, spill percentages, or spill caps) will be adaptively managed in-season as needed to avoid or minimize poor juvenile or adult fish passage conditions, navigation safety concerns, or to accommodate powerhouse or transmission constraints. Actual spill levels may be adaptively managed from those displayed in the table below for research or other conditions and will be coordinated through the Technical Management Team (TMT) or other appropriate regional forum. Such conditions are discussed in more detail below.

### **Management of Spill for Fish Passage**

The Corps will continue to manage spill for fish passage to avoid exceeding 120% in the project tailrace, and 115% in the forebay of the next project downstream consistent with the current State of Washington total dissolved gas (TDG) saturation upper limits.<sup>1</sup> These levels are referred to as "gas caps." The project maximum flow rate or spill discharge level that meets but does not exceed the gas caps, is referred to as the "spill cap." The gas caps are constant, whereas, spill caps may vary daily depending on flow, temperature, and other environmental conditions.

As noted above, the spill rates presented in Table 1 are the planned spring spill operations and assume average runoff conditions; however, adjustments to these spill rates may be necessary for the following reasons:

1. high runoff conditions where flows exceed the powerhouse hydraulic capacity with the specified spill rates;
2. navigation safety concerns;
3. generation unit outages that reduce powerhouse capacity;
4. power system or other emergencies that reduce powerhouse discharges; and,
5. a lack of power demand resulting in an increase in the rate of spill.

Spill below the specified rates could also occur during low runoff conditions when meeting minimum generation levels at a project requires reducing spill rates. This would most likely occur in April. Minimum generation and spill rates are included below in the project specific information.

The Corps' Reservoir Control Center (RCC) is responsible for daily management of TDG responsive to changing conditions. In order to manage gas cap spill rates consistent with the States' TDG saturation limits, RCC establishes the spill caps for each project on the lower Columbia and Snake rivers on a daily basis throughout the fish passage season.

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<sup>1</sup> 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 2009.

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 flow, flow through the powerhouse, wind and temperature forecast, etc.). This information is used as input into the System TDG (SYSTDG) modeling tool. The SYSTDG model estimates TDG levels in the rivers 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 in daily spill priority requests will be met at the projects by using the spill pattern in the appropriate FPP spill table which most closely corresponds to the requested spill (i.e. may be slightly over or under). During the spring freshet when flows are often expected to be greater than hydraulic capacity with the specified spill rates at the dams, or if a lack of power load results in an increase in the spill rate, 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 to minimize 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 by project sections below. Spill caps will be established at the specified amounts 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 2359 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 quantities at dams will be slightly greater or less than specified in Table 1 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.

#### **Operations Considerations:**

- **Spill discharge rates:** Due to limits in the precision of spill gates and control devices, short term flow variations, and head changes, it is not possible to discharge exactly the spill rates stated in Table 1, or as stated in RCC spill requests (teletypes) to projects that call for specific spill discharges. Therefore, spillway gates are opened to

the settings in FPP spill pattern tables, which provide discharges that are the closest to the spill discharge rates. The spill rates in Table 1 coincide with specific gate settings in the FPP spill tables. Actual spill may be higher or lower than the identified spill rate due to low flow conditions, periods of minimum generation, spill cap limitations on spill amounts, spill curtailment for navigation safety, and other circumstances.

- **Spill percentages:** Spill percentages are considered target spill levels. The project control room operator and BPA duty scheduler calculate spill rates to attempt to be within +/- 1% of the target percentage for the following hour (or +/- 1.5% at Little Goose Dam when flows are less than 30 kcfs). These percentages may not be attained due to low flow conditions, periods of minimum generation, spill cap limitations on spill amounts, spill curtailment for navigation safety, and other circumstances. Operators and schedulers will review the percentages achieved during the day and adjust spill rates in later hours, with the objective of ending the day with a day average spill that achieves the target.

### **Minimum Generation**

The Corps has identified minimum generation flow values derived from FPP tables which specify turbine operation within the 1% of best efficiency range. These values are approximations and do not account for varying head or other small adjustments that may result in variations in 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 and cannot precisely control a unit; variations can be +/- 1% to 2% of generation.
3. System disturbances: once the 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 flow and generation slightly within an hour.
4. Individual units may operate slightly differently or have unit specific constraints.
5. Generation control systems regulate megawatts (MW) generation only, and not flow through turbines.

All of the lower Snake River powerhouses may be required to keep one generating unit on line at all times for power system reliability, which may result in a reduction of spill at that project. During low flows, one generator runs at the lower end of the 1% of best efficiency range. All of the Snake River plants have two "families" of turbines with slightly different capacities. In most cases one of the smaller units, with somewhat less generation and flow, will be online during these times. The smaller units are generally numbered 1 – 3 and are the first priority for operation during the fish passage season. An exception to this is at Ice Harbor Dam, where the unit priority list has been modified to accommodate the transformer bank outage at Sacajawea. Also, if smaller units are unavailable, one of the larger units may be used. Further, at Lower Monumental, generating unit 1, which is the first priority unit during fish passage, was damaged, then

welded and consequently cannot operate at the low end of the design range. In addition, Ice Harbor units cannot be operated at the lower end of the 1% of best efficiency range. These units experience cavitation at a generation level somewhat higher than the lower 1% limit, which damages the turbine and can be detrimental to fish. Therefore, Ice Harbor units will operate at their lower cavitation limits. Minimum generation flows are 50kcfs at McNary, John Day and The Dalles and 30 kcfs at Bonneville.

### **Low Flow Operations**

Low flow operations on Lower Snake projects are triggered when inflow is not sufficient to provide for both minimum generation and the planned spill levels. In these situations, the projects will operate one unit at minimum generation and spill the remainder of flow coming into the project. 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 nonfederal projects upstream are 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). Since these projects have limited operating flexibility, maintaining minimum generation and the target spill may not be possible on every hour.

During low flow conditions, when the navigation lock is being emptied, the total spill remains unchanged but the spill stated 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 flows are higher.

At Little Goose Dam, when day average flows in the lower Snake River are below about 40 kcfs, achieving 30% spill requires changing turbine operations between 2 units at the low end of the 1% of best efficiency range and one unit at the high end of the 1% range. This operation is incompatible with the more constant discharge upstream at Lower Granite Dam. It is also difficult to meet the constant FOP spill level downstream at Lower Monumental Dam. The unsteady flow at Little Goose also impacts that project's reservoir operation and can cause inadequate navigation depths at the downstream sill of the Lower Granite navigation lock. In 2008, through coordination with TMT during these low flow periods, Little Goose spill changed from the 30% level in the FOP to a flat spill pattern of approximately 11 kcfs to smooth out Little Goose discharges, meet Lower Monumental spill levels, and maintain the MOP operating range at Little Goose. A similar operation, modified as necessary to include any configuration or operational changes, will be implemented in 2009 if needed during low flow periods, in coordination with 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, adjustments to pool elevation in the Little Goose pool of up to 1.0 foot above the MOP operating range may be necessary to accommodate safe navigation at Lower Granite Dam during periods of low flow (approximately 40 kcfs or less). These adjustments may be necessary for both commercial tows and fish barges.

## **2009 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, at

Lower Monumental, fish run timing and research schedules may require an earlier transition date to summer operations. Such changes will be coordinated through TMT. Spring spill levels are shown in Table 1.

**Lower Columbia River Projects**

Spring spill will begin April 10 at McNary, John Day, The Dalles, and Bonneville dams through June 30. Spring spill operations will continue through June 30 at McNary, John Day, and The Dalles dams, and through June 20 at Bonneville Dam. However, fish run timing and research schedules may require an earlier transition date to summer spill operations at McNary Dam. Such changes will be coordinated through TMT. Spring spill levels are shown in Table 1.

**Table 1 - Summary of 2009 spring spill levels at lower Snake and Columbia River projects.<sup>2</sup>**

<b>Project</b>	<b>Planned Operations for Spring 2009 (Day/Night)</b>	<b>Comments</b>
Lower Granite	<b>20 kcfs/20 kcfs</b>	Same as 2008
Little Goose	<b>30%/30%</b>	To accommodate new spillway weir testing, 14 nights of gas cap spill used in 2008 will not occur
Lower Monumental	<b>gas cap/gas cap</b>	Same as 2008
Ice Harbor	<b>30%/30% vs. 45 kcfs/gas cap</b>	Same as 2008
McNary	<b>40%/40%</b>	Same as 2008
John Day	<b>30%/30% on pre-test days; 30%/30% vs. 40%/40%</b>	0%/60% on pre-test days in 2008
The Dalles	<b>40%/40%</b>	Same as 2008
Bonneville	<b>100 kcfs/100 kcfs</b>	Same as 2008

<sup>2</sup> Table 1 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.”

## **SPRING FISH OPERATIONS BY PROJECT**

The following describes the 2009 spring spill operations for each project. Included in the description are planned research activities identified in the 2008 BiOp. The Corps, regional agencies, and Tribes are interested in the continuation of project research studies under the Corps' Anadromous Fish Evaluation Program (AFEP). The 2009 studies have been through the annual AFEP review process with the regional agencies and Tribes, with the study designs being finalized in an interagency meeting held on January 15, 2009. The studies are intended to provide further information on project survival and assist the region in making decisions on future operations and configuration actions to improve fish passage and survival at the lower Snake and Columbia River dams.

### **Lower Granite**

**Spring Spill Operations April 3 through June 20, 2009:** 20 kcfs (including approximately 6 kcfs from the RSW and 14 kcfs from training spill) 24 hours per day.

#### **Changes in Operations for Research Purposes:**

- Spring research operations: Normal spring spill patterns and rates as described in the FPP will be used. There will be no alternate spill operations for testing.

#### **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 of high flow spring runoff when involuntary spill occurs, there may be periods where 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 runoff conditions occur, spill 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, Lower Granite pool MOP elevation restrictions will be temporarily exceeded until the barge exits the tailrace safely.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.

### **Little Goose**

**Spring Spill Operations April 3 through June 20, 2009:** 30% spill 24 hours per day.

#### **Changes in Operations for Research Purposes:**

- Spill duration for testing: Juvenile passage and survival will be studied throughout the spring spill period.
- Preseason testing for direct injury of the spillway weir will occur using minimal spill from March 11 to April 3 in spill bays 1 and 8.

- Spring research operations: 30% spill 24 hour/day. Spillway weir plus one uniform spill pattern will be tested in the spring. Final test conditions will be coordinated through FPOM and/or the Studies Review Work Group (SRWG).
- Objectives of the biological test: The objectives of this study include: (1) Determine the timing and route of passage for yearling Chinook salmon, and juvenile steelhead relative to spillway weir spill and powerhouse operations; (2) Estimate route-specific and overall concrete survival of hatchery yearling Chinook and hatchery steelhead; (3) Determine the effects of spillway weir operation and associated training spill, as well as powerhouse operations, on smolt approach paths in the forebay; (4) Determine direct survival and injury rates of fish passing through the spillway weir and spill bay 8; (5) Estimate survival (concrete) as the first year to determine if BiOp performance standards are being met with the tested configuration and operation.
- Spill pattern during the biological test: The test spill patterns will be developed in coordination with SRWG. Additional modeling efforts at ERDC may be needed if spill test results reveal unacceptable impacts on adult or juvenile fish passage.

### **Operational Considerations:**

- Day average flows in the lower Snake River below about 40 kcfs can result in incompatible operations with Lower Monumental Dam and cause spill quantity fluctuations. Little Goose operations to resolve this issue are described in the Low Flow Operations section above (page 5).
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.
- Turbine Unit 1 Operation: For 2009, a new more limited 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 kcfs). This will ensure a strong flow along the south shore to counter the strong eddy that forms during certain spill conditions. A strong south shore current is important for both adult fish passage and juvenile fish egress. Special turbine operations are expected to continue through the spring and summer spill periods until river flow can support only one operating turbine unit. Once low flow conditions occur, the full 1% of best efficiency range will be restored.

### **Lower Monumental**

**Spring Spill Operations April 3 through approximately June 20, 2009:** Spill to the 115/120% TDG spill cap 24 hours per day with the RSW operating.

### **Changes in Operations for Research Purposes:**

- Spill duration for testing: The test is expected to start in mid-April (contingent on juvenile fish numbers) and will last until early June. The dates of testing will be dependent on the size of fish and fish availability. Final dates for testing will be coordinated through FPOM and/or SRWG.

- Spring research operations: A two treatment test will be conducted, utilizing the 2008 modified bulk spill pattern versus the 2003 uniform (flat) pattern modified for the RSW in spill bay 8. Pattern changes will occur at 0530 hours. However, if the runoff forecast is high, a one treatment study would be conducted as the higher the spill levels the more similar the two patterns become. The modified bulk spill pattern will be used on non-test days.
- Objectives of the biological test: The objectives of the study are to assess passage distribution and efficiency metrics, forebay retention, tailrace egress, vertical distribution of run-at-large fish passing over the RSW, and survival for yearling Chinook and steelhead for two spill pattern treatments, a bulk spill pattern and a uniform pattern in conjunction with RSW operation. This will be the second year of testing of the RSW at Lower Monumental Dam. An additional objective will be to estimate survival (concrete) to determine if BiOp performance standards are being met with the tested configuration and operation.
- Spill pattern during the biological test: Spill patterns used during the 2008 study will be used again in 2009.

### **Operational Considerations:**

- Daily average flows near 30 kcfs results in incompatible operations with Little Goose Dam and results in spill quantity fluctuation.
- The Lower Monumental spill cap is affected by Little Goose Dam operations. Therefore, spill discharge could be lower than 27 kcfs.
- The RSW was installed in March 2008 and will continue to operate with biological testing in 2009.
- Transit of the juvenile fish barge across the Lower Monumental tailrace, then docking at and disembarking from the fish collection facility, may require the level of spill to be reduced due to safety concerns. The towboat captain may request that spill be reduced or eliminated during transit. During juvenile fish loading operations, spill is typically reduced to 15 kcfs, but can be reduced further if needed for safety reasons. Loading periods can take 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 Lower Monumental to briefly operate outside of MOP conditions.
- Operating units within the 1% of best efficiency range yields up to 19 kcfs per unit at each of the 6 units for a maximum hydraulic capacity of approximately 114 kcfs. The expected spill cap is 27 kcfs. 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 will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. Dates are subject to change.

## Ice Harbor

**Spring Spill Operations April 3 through June 20, 2009:** In accordance with the test schedule, alternate between 45 kcfs day/spill cap night and 30% /30% with the RSW operating, similar to that used in 2008. Nighttime spill hours are 1800 – 0500.

### **Changes in Operations for Research Purposes:**

- Spring research operations: Normal spring spill patterns and rates as described in the FPP will be used. Radio tagged fish will be monitored for passage route and survival. The test is expected to start in mid-April (contingent on juvenile fish numbers), following release at Lower Monumental Dam, and will last until early June. The dates of testing will be dependent on the size of fish and fish availability. Spill will be 45 kcfs day / spill cap night on non-test days. Final dates for testing will be coordinated through FPOM and/or SRWG.
- Objectives of the biological test: The objectives of the test are to determine passage routes and estimate route-specific and concrete survival under the two spill conditions for yearling Chinook and steelhead.
- Spill pattern: Spill patterns will be verified and coordinated through FPOM and/or SRWG.

### **Operational Considerations:**

- 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 limits set by the States of Oregon and Washington.
- Minimum generation or higher powerhouse operation will occur at all times during the 2009 spring fish spill season. This is due to a transformer failure at BPA's Sacajawea transmission facility near the project. Mobile capacitor groups remain in use at BPA's Franklin transmission facility to partially resolve power system issues. In addition, continuous generation is required at Ice Harbor Dam for power system stability and reliability. Normal unit operating priorities will be re-established when the Sacajawea transformer is returned to service.
- 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.

- In November 2006, a major transformer failed at the Sacajawea Substation which in turn restricts turbine operations at Ice Harbor Dam. Transformer design, build and replacement are expected to be completed by July 2009. Additionally, powerhouse transformer TW-6 is experiencing gassing during operation due to internal arcing. Because of power distribution restrictions, the turbine unit priority will be 3, 1, 4, 5, 2 and 6 until the transformers are replaced. If unit 3 is not available, unit 4 will become the first priority unit.

### McNary

**Spring Spill Operations April 10 – approximately June 30, 2009:** 40% spill 24 hours per day with spillway weirs operating. See Table 1 for operational spill levels.

#### **Changes in Operations for Research Purposes:**

- Spill duration for testing: Approximately April 20 to early June (tentative). 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: 40% spill 24 hours/day with a single treatment for the third year of spillway weir testing. One project spill configuration will be tested. The same spill level as past years will be used, in order to maximize the power to detect the effect of spillway weir location. Final test conditions will be coordinated through the SRWG.
- Objectives of the biological test:
  - Primary objective: Determine the effect of spillway weir location on the behavior, passage distribution, and passage efficiencies of yearling Chinook and juvenile steelhead.
  - Secondary objective: Estimate route specific, dam, and concrete survival of yearling Chinook and juvenile steelhead for the tested configuration and operation.
- Spill pattern: As outlined in an addendum to the FPP. The Corps' Walla Walla District will coordinate with Tribes and regional fishery managers to evaluate modifications to the 2008 spill pattern for the 2009 configuration with ERDC general model observations. Test spill patterns are provided in the FPP.

#### **Operational Considerations:**

- Spillway weir 1 (relocated from spill bay 19) is located in spill bay 4. Spillway weir 2 remains in spill bay 20.
- 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 during any given spill treatment at total river discharges 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, 2009:** 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 be alternated every two days. Spill level changes will occur at 0600. See Table 1 for operational spill levels.

### **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 2008 spillway weir test is presented here for planning purposes, however details such as spill pattern, spill level, and spill duration may change based on 2008 study results. These changes will be coordinated through the SRWG and TMT. Two spillway weirs that pass about 10 kcfs spill each are installed in spill bays 15 and 16. 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 15 and 16 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. Pending review of 2008 results, pre-test spill in 2009 will utilize the 30% spillway weir spill pattern developed and tested in 2008. 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, 2009:** 40% spill 24 hours per day. See Table 1 for operational spill levels.

### **Changes in Operations for Research Purposes:**

- Spill pattern during the biological test: No testing is planned for 2009. The spill patterns in the FPP will be used.

### **Operational Considerations:**

- When high river flows are such that available spill bays 1 – 9 cannot maintain 40% spill, FPOM and TMT will discuss the preferred spill pattern and rate. The project may maintain 40% spill of the total river flow and depart from the spill pattern, or spill less than 40% of the total river flow using a pattern other than that shown in the FPP. 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.
- One or two full spillway outages may be required to conduct hydro surveys during the period June 10 – 20, to assess the condition of the mud leveling slab at the spill wall under construction between spill bays 8 and 9. Each zero spill operation will last 3 – 6 hours to accommodate this work. The hydro surveys will be coordinated through the Fish Facility Design Review Work Group (FFDRWG), FPOM, and RCC.
- 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, 2009:** 100 kcfs spill 24 hours per day. See Table 1 for operational spill levels.

### **Changes in Operations for Research Purposes:**

- Spill duration for testing: No special spill operations are required for 2009 biological tests. FPP spill patterns and durations will be used.
- Spring research operations: 100 kcfs spill 24 hours/day.
- Objectives of the biological test: Estimate juvenile yearling Chinook and steelhead passage distribution in response to a behavioral guidance structure at the second powerhouse.
- Spill pattern during the biological test: Spill patterns in the FPP will be used.

## **Operational Considerations:**

- Minimum spill discharge rate is 50 kcfs. 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).
- TMT will consider the possible effects of TDG on emerging chum salmon downstream of Bonneville Dam. TMT may request special operations such as flow increases or spill reductions to protect ESA-listed fish.
- Unit outages will occur for required maintenance activities. The outage schedule for the project is shown in the FPP. 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 1. 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 to the afternoon of August 31, 2009.
- A mid-season spillway outage will be required to survey the stilling basin for erosion. Pending the outcome of this survey, the 2009 spill operation may be altered to maintain dam safety. Changes to spill operations may include changing the spill pattern to avoid further erosion or discontinuing spill until repairs can be made. The mid-season survey will take approximately ½ day to complete. The Corps will coordinate this work through FFDRWG, FPOM, and TMT.
- Fish releases from the Spring Creek National Fish Hatchery in April and May may result in turbine flow reductions at the second powerhouse for safer fish passage, in coordination with TMT.

## **JUVENILE FISH TRANSPORTATION PROGRAM OPERATIONS**

As noted above, the Corps' planned spill operations assume average runoff conditions. The following explains the juvenile fish transportation program under all runoff conditions and is consistent with the 2008 transport operations derived from agreements reached in 2007. The lower Snake River projects are described first, followed by McNary project operations. Detailed descriptions of project and transport facility operations to implement the program are contained in FPP Appendix B.

### **Lower Snake River Dams - Operation and Timing**

If the Snake River projected seasonal average (April 3 – June 20) flow is greater than 70 kcfs, the Corps will initiate transportation at Lower Granite Dam no earlier than April 20 and no later than May 1. The seasonal average flow projection will be based on the Corps' Single Trace Procedure (STP) model and the April final water supply forecast for Lower Granite. The actual start date in 2009 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). Also if the projected flow is greater than 70 kcfs, transportation will start up to 8 days and up to 11 days after the Lower Granite Dam start date for Little Goose and Lower Monumental dams, respectively. The actual start dates at Little Goose and Lower Monumental dams will be further considered through the TMT process, depending on in-season river conditions and the status of the juvenile Chinook and steelhead runs.

In exceptionally low water years, when the projected seasonal average flow is less than 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.

April 20 – June 20: 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 concurrent with spill operations at each project and in accordance with all relevant FPP operating criteria.

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.

### **Transportation Considerations:**

Transportation operations will be carried out concurrent with the 2009 FOP spill operations at each project and in accordance with all relevant FPP operating criteria.

- Lower Granite: All ESBSs will be installed by March 30. If projected seasonal average flow is greater than 70 kcfs, juvenile fish will be bypassed via normal separator operations and routed to the mid-river release outfall starting March 30 through April 20. All juvenile fish collected will be interrogated for PIT tags and normal 24-hour sampling for the Smolt Monitoring Program will take place. On April 6, juvenile fish collection will begin for research (Seasonal SAR and Reach Survival Studies), followed by tagging on April 7 and 8. The first research barge will leave on April 9 and every Thursday thereafter, until operational fish transportation begins.
- Little Goose and Lower Monumental: All ESBSs and STSs will be installed by March 31. If the projected seasonal average flow is greater than 70 kcfs, juvenile fish will be interrogated for PIT tags at the full flow PIT tag detector. All juvenile fish will be interrogated for PIT tags and limited sampling may take place every 3 to 5 days to monitor fish condition. A full sample may be taken every other day to monitor species composition to help inform a decision on initiating transportation at these projects. At Lower Monumental, daily smolt monitoring for the avian predation study will occur beginning April 1 and 100 steelhead, each day or total for the test, will be PIT-tagged to assess avian prey selection. Study fish for the Lower

Monumental survival study will be collected at Lower Monumental. Study fish for the Little Goose survival study will be collected at Little Goose.

### **McNary Dam - Operation and Timing**

Spring: Juvenile fish collected at McNary during the spring, April 1 through June 20, 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.

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 the TMT coordination process.

All ESBSs at McNary will be installed by April 17, as agreed to in consultation with 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.

The normal operation will be to bypass fish through the full flow bypass pipe, which has interrogation capability to monitor for PIT tags. However, in order to sample fish for the Smolt Monitoring Program, fish will be routed through the separator on an every other day basis for PIT tag interrogation and then bypassed to the river.

## **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, 2009. 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, 2009 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.

### **Avian Predation**

A study will be conducted to evaluate the impacts of avian predation on salmonid smolts from the Columbia and Snake rivers. The study will determine how various biotic and abiotic factors are associated with differences in steelhead smolt vulnerability to predation by Crescent Island terns and Foundation Island cormorants. The study requests PIT tagging both hatchery and wild steelhead collected in the smolt monitoring sample at Lower Monumental and Ice Harbor dams, beginning April 1 and continuing through July. The recorded condition of a fish will be attached to a specific tag code and vulnerability to avian predation will be evaluated using PIT tag recovery data collected from the avian bird colonies. The study needs a minimum sample of 100 fish each day that are collected for condition by the smolt monitoring program.

### **EMERGENCY PROTOCOLS**

The Corps and the Bureau of Reclamation will operate the projects in emergency situations in accordance with the WMP Emergency Protocols (WMP Appendix 1). The Protocols define emergency conditions and situations that may arise while operating the FCRPS projects, and the immediate actions that may be taken in the face of the emergency. The most recent version of the Emergency Protocols is located at: <http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/2008/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 2009 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/](http://www.nwd-wc.usace.army.mil/ftppub/water_quality/12hr/html/)

## **2009 Summer Fish Operations Plan**

### **BACKGROUND**

The 2009 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 2009 summer fish migration season. The 2009 Summer FOP is consistent with the adaptive management provisions in the 2008 NOAA Fisheries FCRPS Biological Opinion (2008 BiOp) and the Corps' Record of Consultation and Statement of Decision (ROCASOD) adopting the project operations contained in the 2008 BiOp and the Columbia Basin Fish Accords (Accords).

As in 2008, the 2009 Summer FOP incorporates planned operational adjustments necessary to perform essential research, and to accommodate the adjustment of surface bypass structures or other features for the 2009 summer migration season. The FCRPS water management and project operations not specifically addressed in this 2009 Summer FOP are consistent with the 2008 BiOp and other operative documents including the 2009 Water Management Plan (WMP), seasonal WMP updates, and the 2009 Fish Passage Plan (FPP). As in 2008, operations may be adjusted through coordination with regional sovereigns.

The following sections describe: factors that influence management of fish operations during various runoff conditions, including TDG management, spillway operations, and minimum generation; specific summer operations for fish passage at each mainstem project; the juvenile fish transportation program operations; protocols for emergencies; coordination with the region; and, monthly reporting.

### **GENERAL CONSIDERATIONS FOR FISH OPERATIONS**

For planning purposes, the Corps' 2009 Summer FOP spill levels, summarized in Table A below, assume "average" run-off conditions. However, because actual run-off conditions vary in timing and shape and may be higher or lower than average, adjustments in spill levels (kcfs discharge rates, spill percentages, or spill caps) will be adaptively managed in-season as needed to avoid or minimize poor juvenile or adult fish passage conditions, navigation safety concerns, or to accommodate powerhouse or transmission constraints. Actual spill levels may be adaptively managed from those displayed in the table below for research or other conditions and will be coordinated through the Technical Management Team (TMT) or other appropriate regional forum. Such conditions are discussed in more detail below.

## Management of Spill for Fish Passage

The Corps will continue to manage spill for fish passage to avoid exceeding 120% in the project tailrace, and 115% in the forebay of the next project downstream consistent with the current State of Washington total dissolved gas (TDG) saturation upper limits.<sup>1</sup> These levels are referred to as “gas caps.” The project maximum flow rate or spill discharge level that meets but does not exceed the gas caps, is referred to as the “spill cap.” The gas caps are constant, whereas, spill caps may vary daily depending on flow, temperature, and other environmental conditions.

As noted above, the spill rates presented in Table A are the planned summer spill operations and assume average runoff conditions; however, adjustments to these spill rates may be necessary for the following reasons:

1. high runoff conditions where flows exceed the powerhouse hydraulic capacity with the specified spill rates;
2. navigation safety concerns;
3. generation unit outages that reduce powerhouse capacity;
4. power system or other emergencies that reduce powerhouse discharges; and,
5. a lack of power demand resulting in an increase in the rate of spill.

Spill below the specified rates could also occur during low runoff conditions when meeting minimum generation levels at a project requires reducing spill rates. This would most likely occur in July and August. Minimum generation and spill rates are included below in the project specific information.

The Corps’ Reservoir Control Center (RCC) is responsible for daily management of TDG responsive to changing conditions. In order to manage gas cap spill rates consistent with the States’ TDG saturation limits, 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 flow, flow through the powerhouse, wind and temperature forecast, etc.). This information is used as input into the System TDG (SYSTDG) modeling tool. The SYSTDG model estimates TDG levels in the rivers several days into the future, and is a tool integral to daily decision-making when establishing spill caps at individual dams.

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<sup>1</sup> 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% limits (the Washington TDG standard) in 2009.

Spill caps set by RCC in daily spill priority requests will be met at the projects by using the spill pattern in the appropriate FPP spill table which most closely corresponds to the requested spill (i.e. may be slightly over or under). During the freshet when flows are often expected to be greater than hydraulic capacity with the specified spill rates at the dams, or if a lack of power load results in an increase in the spill rate, 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 to minimize TDG throughout the system.

In accordance with the 2009 Spring FOP, spring spill operations commenced on April 3 at 0001 hours for the Corps' lower Snake projects and on April 10 at 0001 hours for the lower Columbia projects. Spill caps have been established at the specified amounts 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 2359 hours, or shortly before midnight, at each project just prior to the summer start 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 quantities at dams will be slightly greater or less than specified in Table A 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 rates:** Due to limits in the precision of spill gates and control devices, short term flow variations, and head changes, it is not possible to discharge exactly the spill rates stated in Table A, or as stated in RCC spill requests (teletypes) to projects that call for specific spill discharges. Therefore, spillway gates are opened to the settings in FPP spill pattern tables, which provide discharges that are the closest to the spill discharge rates. The spill rates in Table A coincide with specific gate settings in the FPP spill tables. Actual spill may be higher or lower than the identified spill rate due to low flow conditions, periods of minimum generation, TDG spill cap limitations on spill amounts, spill curtailment for navigation safety, and other circumstances.
- **Spill percentages:** Spill percentages are considered target spill levels. The project control room operator and BPA duty scheduler calculate spill rates to attempt to be within +/- 1% of the target percentage for the following hour (or +/- 1.5% at Little Goose Dam when flows are less than 30 kcfs). These percentages may not be attained due to low flow conditions, periods of minimum generation, TDG spill cap

limitations on spill amounts, spill curtailment for navigation safety, and other circumstances. Operators and schedulers will review the percentages achieved during the day and adjust spill rates in later hours, with the objective of ending the day with a day average spill that achieves the target.

### **Minimum Generation**

The Corps has identified minimum generation flow values derived from FPP tables which specify turbine operation within the 1% of best efficiency range. These values are approximations and do not account for varying head or other small adjustments that may result in variations in 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 and cannot precisely control a unit; variations can be +/- 1% to 2% of generation.
3. System disturbances: once the 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 flow and generation slightly within an hour.
4. Individual units may operate slightly differently or have unit specific constraints.
5. Generation control systems regulate megawatts (MW) generation only, and not flow through turbines.

All of the lower Snake River powerhouses may be required to keep one generating unit on line at all times for power system reliability, which may result in a reduction of spill at that project. During low flows, one generator runs at the lower end of the 1% of best efficiency range. All of the Snake River plants have two "families" of turbines with slightly different capacities. In most cases one of the smaller units, with somewhat less generation and flow, will be online during these times. The smaller units are generally numbered 1 – 3 and are the first priority for operation during the fish passage season. An exception to this is at Ice Harbor Dam, where the unit priority list has been modified to accommodate the transformer bank outage at Sacajawea. Also, if smaller units are unavailable, one of the larger units may be used. Further, at Lower Monumental, generating unit 1, which is the first priority unit during fish passage, was damaged, then welded in a fixed blade configuration. Consequently the unit cannot operate at the low end of the design range. In addition, Ice Harbor units cannot be operated at the lower end of the 1% of best efficiency range. These units experience cavitation at a generation level somewhat higher than the lower 1% limit, which damages the turbine and can be detrimental to fish. Therefore, Ice Harbor units will operate at their lower cavitation limits. Minimum generation flows are 50 kcfs at McNary, John Day and The Dalles and 30 kcfs at Bonneville.

## **Low Flow Operations**

Low flow operations at lower Snake River projects are triggered when inflow is not sufficient to provide for both minimum generation and the planned spill levels. In these situations, the projects will operate one unit at minimum generation and spill the remainder of flow coming into the project. As flows transition from higher flows to lower flows, there may be situations when flows recede at a higher rate than forecasted. In addition, inflows provided by nonfederal projects upstream are 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). Since these projects have limited operating flexibility, maintaining minimum generation and the target spill may not be possible on every hour.

During low flow conditions, when the navigation lock is being emptied, the total spill remains unchanged but the spill stated 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 flows are higher.

At Little Goose Dam, when day average flows in the lower Snake River are below about 40 kcfs, achieving 30% spill requires changing turbine operations between 2 units at the low end of the 1% of best efficiency range and one unit at the high end of the 1% range. This operation is incompatible with the more constant discharge upstream at Lower Granite Dam. It is also difficult to meet the constant FOP spill level downstream at Lower Monumental Dam. The unsteady flow at Little Goose also impacts that project's reservoir operation and can cause inadequate navigation depths at the downstream sill of the Lower Granite navigation lock. In 2008, through coordination with TMT during these low flow periods, Little Goose spill changed from the 30% level in the FOP to a flat spill pattern of approximately 11 kcfs to smooth out Little Goose discharges, meet Lower Monumental spill levels, and maintain the MOP operating range at Little Goose. A similar operation, modified as necessary to consider configuration or operational changes such as spillway weir and turbine unit 1 operations, will be implemented in 2009 if needed during low flow periods, in coordination with 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, adjustments to pool elevation in the Little Goose pool of up to 1.0 foot above the MOP operating range may be necessary to accommodate safe navigation at Lower Granite Dam during periods of low flow (approximately 40 kcfs or less). These adjustments may be necessary for both commercial tows and fish barges.

## **2009 SUMMER SPILL OPERATIONS**

### **Lower Snake River Projects**

Summer spill will begin on June 21 at Lower Granite, Little Goose, and Ice Harbor dams. However, at Lower Monumental Dam, fish run timing and research schedules may require transitioning to summer spill earlier than June 21. Such changes will be coordinated through TMT. Summer spill will occur through August 31, 2009 at all four lower Snake River projects. Summer spill levels are shown in Table A.

### Lower Columbia River Projects

Summer spill will begin July 1 at John Day and The Dalles dams, and will begin June 21 at Bonneville Dam. However, at McNary Dam, fish run timing and research schedules may require transitioning to summer spill earlier than July 1. Such changes will be coordinated through TMT. Summer spill will occur through August 31, 2009 at all four projects. Summer spill levels are shown in Table A.

**Table A. Summary of 2009 summer spill levels at lower Snake and Columbia River projects.<sup>2</sup>**

<b>Project</b>	<b>Planned Operations for Summer 2009 (Day / Night)</b>	<b>Comments</b>
Lower Granite	<b>18 kcfs / 18 kcfs</b>	Same as 2008
Little Goose	<b>30% / 30%</b>	Same as 2008
Lower Monumental	<b>17 kcfs / 17 kcfs</b>	Same as 2008
Ice Harbor	<b>45 kcfs / gas cap on non-test days; 30% / 30% or 45 kcfs / gas cap on test days</b>	Same as 2008
McNary	<b>40% / 40% or 60% / 60%</b>	Same as 2008
John Day	<b>30% / 30% on non-test days; 30% / 30% or 40% / 40% on test days</b>	Same as 2008
The Dalles	<b>40% / 40%</b>	Same as 2008
Bonneville	<b>85 or 75 kcfs day / gas cap night</b> (85 kcfs day through July 20, then 75 kcfs day through August 31)	Same as 2008

### **SUMMER FISH OPERATIONS BY PROJECT**

The following describes the 2009 summer spill operations for each project. Included in the description are planned research activities identified in the 2008 BiOp. The Corps, regional agencies, and Tribes are interested in the continuation of project research studies under the Corps' Anadromous Fish Evaluation Program (AFEP). The 2009 studies have been through the annual AFEP review process with the regional agencies and Tribes, with the study designs being finalized in an interagency meeting held on January 15, 2009. The studies are intended to provide further information on project survival and

<sup>2</sup> Table A displays in summary form the planned summer spill operations. More specific detail governing project operations is in the section entitled "Summer Fish Operations By Project."

assist the region in making decisions on future operations and configuration actions to improve fish passage and survival at the lower Snake and Columbia River dams.

### **Lower Granite**

**Summer Spill Operations June 21 through August 31, 2009:** 18 kcfs (including approximately 6 kcfs from the RSW and 12 kcfs from training spill) 24 hours per day. See Table A for operational spill levels.

#### **Changes in Operations for Research Purposes:**

- Summer research operations: Normal summer spill patterns and rates as described in the FPP will be used. An alternate (bulk) spill pattern may be used at Lower Granite in summer, as discussed and recommended at the April 2009 FFDRWG meeting. This pattern was evaluated in 2006 and 2007 and will have the same spill level as the FPP spill pattern. There will be no specific spill level variations for testing.

#### **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 high flow periods when involuntary spill occurs, there may be periods where 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 runoff conditions occur, spill 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.
- Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. If such low runoff conditions occur, alternative spill operations at the dam will be coordinated through the TMT.
- Minimum generation: The minimum generation amount represents the operation of one unit at the lower end of its 1% of best efficiency range and is needed for power system reliability. This operation will result in individual turbine flows of approximately 11.3 kcfs – 13.1 kcfs at units 1 – 3 and 13.5 kcfs - 14.5 kcfs at units 4 - 6. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This condition may occur in early spring before the freshet and during the late summer period with low flow conditions.
- 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.

## Little Goose

**Summer Spill Operations June 21 – August 31, 2009:** 30% spill 24 hours per day. See Table A for operational spill levels.

### **Changes in Operations for Research Purposes:**

- Spill duration for testing: Juvenile passage will be studied throughout the summer spill period.
- Summer research operations: 30% spill 24 hour/day. The spill pattern used in the spring will be continued in the summer. Final test conditions will be coordinated through FPOM and/or Studies Review Work Group (SRWG).
- Objectives of the biological test: The goals of this study include: (1) Determine the timing and route of passage for sub-yearling Chinook salmon relative to spillway weir spill and powerhouse operations; (2) Estimate route-specific and overall concrete survival of sub-yearling Chinook; (3) Determine the effects of spillway weir operation and associated training spill, as well as powerhouse operations, on smolt approach paths in the forebay of Little Goose Dam; (4) Estimate survival (concrete) as the first year to determine if BiOp performance standards are being met with the tested configuration and operation.
- Spill pattern during the biological test: The test spill patterns have been developed through ERDC modeling and in coordination with FPOM and/or SRWG.

### **Operational Considerations:**

- Day average flows in the lower Snake River below about 40 kcfs can result in incompatible operations with Lower Monumental Dam and cause spill quantity fluctuations. Little Goose operations to resolve this issue are described in the Low Flow Operations section above (page 5).
- 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.
- Turbine Unit 1 Operation: For 2009, a new more limited operating range is 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 kcfs). This will ensure a strong flow along the south shore to counter the strong eddy that forms during certain spill conditions. A strong south shore current is important for both adult fish passage and juvenile fish egress. Special turbine operations are expected to continue through the spring and summer spill periods until river flow can support only one operating turbine unit. Once low flow conditions occur, the full 1% of best efficiency range will be restored, to minimize impacts on spill levels.
- Minimum spill: During periods of low flow before the spring freshet and during the late summer period, there may be periods where spill quantities are so low that it creates tailrace conditions not advantageous to fish passage. If such flow conditions occur, alternative operations at the dam will be coordinated through the TMT.

- **Minimum generation:** The minimum generation amount represents the operation of one unit at the lower end of its 1% efficiency range and is needed for power system reliability. This should result in individual turbine flows of 11.3 kcfs – 13.1 kcfs at units 1 – 3 and 11.5 kcfs – 14.5 kcfs at units 4 – 6. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This situation may occur in early spring before the freshet and during the late summer period with low flow conditions.

### **Lower Monumental**

**Summer Spill Operations Approximately June 21 – August 31, 2009:** Spill 17 kcfs 24 hours per day (subject to 120%/115% TDG spill cap limits) with the RSW operating. See Table A for operational spill levels.

#### **Changes in Operations for Research Purposes:**

- **Spill duration for testing:** Summer testing will begin approximately June 21 or earlier, and lasting until mid-July. The dates of testing will be dependent on the availability of subyearling fall Chinook of sufficient size for tagging. Final dates for testing will be coordinated through FPOM and/or SRWG.
- **Summer research operations:** 17 kcfs 24 hours per day with one spill pattern treatment. The spill pattern will be the pattern used in 2008 and coordinated through FPOM and/or SRWG.
- **Objectives of the biological test:** Estimate passage distribution, survival, forebay retention, tailrace egress, and vertical distribution of fish passing over the RSW for subyearling fall Chinook under one spill pattern. Estimate survival (concrete) to determine if BiOp performance standards are being met with the tested configuration and operation.
- **Spill pattern during the biological test:** The 2008 FPP spill pattern will be used for summer testing.

#### **Operational Considerations:**

- Daily average flows near 30 kcfs results in incompatible operations with Little Goose Dam and results in spill quantity fluctuation.
- As in the spring, the amount of water spilled in the summer at Little Goose may affect the Lower Monumental spill volume (due to elevated TDG levels).
- Transit of the juvenile fish barge across the Lower Monumental tailrace, then docking at and disembarking from the fish collection facility, may require the level of spill to be reduced due to safety concerns. The towboat captain may request that spill be reduced or eliminated during transit. During juvenile fish loading operations, spill is typically reduced to 15 kcfs, but can be reduced further if needed for safety reasons. Loading periods can take 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 Lower Monumental to briefly operate outside of MOP conditions.

- **Minimum spill:** During periods of low flow before the spring freshet and during the summer period, there may be periods when spill quantities are limited so that tailrace conditions are not advantageous to fish passage. This condition is interpreted to be a minimum spill level provided through the spillway weir only (approximately 6.8 kcfs with the reservoir operating at MOP). If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.
- **Minimum generation:** The minimum generation amount represents the operation of one unit at the lower end of its 1% of best efficiency range and is needed for power system reliability. This will result in individual turbine flows of approximately 11.3 kcfs – 13.1 kcfs for units 2 and 3 and 13.5 kcfs – 14.5 kcfs for units 4 – 6 and 16.5 kcfs – 19.5 kcfs for unit 1. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This limit may occur in early spring before the freshet and during the late summer period with low flow conditions.
- **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.

### **Ice Harbor**

**Summer Spill Operations June 21 – August 31, 2009:** Spill 30% 24 hours per day or 45 kcfs day / spill cap night; then 45 kcfs day / spill cap night after the end of the test, with the RSW operating. See Table A for operational spill levels.

#### **Changes in Operations for Research Purposes:**

- **Summer research operations:** Spill patterns will be verified and coordinated through FPOM and/or SRWG. Radio tagged fish will be monitored for passage route and survival.
- **Objectives of the biological test:** The objectives of the test are to determine passage routes and estimate route-specific and concrete survival under the two spill conditions for subyearling Chinook.
- **Spill pattern during the biological test:** Spill patterns will be verified and coordinated through FPOM and/or SRWG.

#### **Operational Considerations:**

- Minimum generation or higher powerhouse operation will occur at all times during the 2009 summer fish spill season, until repairs are complete at BPA's Sacajawea transmission facility near the project. Mobile capacitor groups remain in use at BPA's Franklin transmission facility to partially resolve power system issues. In addition, continuous generation is required at Ice Harbor Dam for power system stability and reliability. Normal unit operating priorities will be re-established when the Sacajawea transformer is returned to service, expected in July 2009.

- **Minimum spill:** During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. The minimum spill for Ice Harbor Dam is 15.2 kcfs, which includes providing spill through the RSW and training spill to ensure good tailrace egress conditions. If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.
- **Minimum generation:** The minimum generation amount represents the operation of one unit at the lower cavitation limit. The cavitation limit is within the 1% of best efficiency range. This will result in individual turbine flows of approximately 8.5 kcfs – 11.5 kcfs at units 1 – 3 and 10.8 kcfs – 13.8 kcfs at units 4 – 6. Unit 2 has been modified by fixing the blades in a single position to eliminate an oil leak. As a result, its MW output and kcfs discharge at the low end of 1% will be higher than the other 5 units. There may be slight variations in the generation due to power system fluctuations. Also, the outflow will fluctuate because of changing head at the dam. This limit may occur in early spring before the freshet and during the late summer period with low flow conditions.
- **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 Approximately July 1 through August 31, 2009:** 40% or 60% spill 24 hours per day, in two day blocks throughout the summer spill period. See Table A for operational spill levels.

#### **Changes in Operations for Research Purposes:**

- Spill duration for testing: Approximately early June through August 3. 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.
- Summer research operations: 40% or 60% spill 24 hours per day. Continue to evaluate spillway weir performance by changing the configuration to optimize the spillway and reduce navigation issues. Each test spill level will occur for two days in a randomized block test design, throughout the period. Two spillway weirs will be in place during the test, located at spill bays 4 and 20.
- Objectives of the biological test:
  - Estimate passage and survival rates of subyearling fall Chinook salmon under two treatments.
  - Characterize subyearling fall Chinook behavior in the forebay of McNary Dam under two treatments.
- Spill pattern during the biological test: Spill patterns have been identified using the general model at ERDC by USACE Walla Walla District staff and representatives of the regional fisheries agencies and tribes. Test spill patterns are modifications of the

2003-2005 flat pattern and the 2008 test pattern to accommodate the new placement of the spillway weirs.

- After the study is complete, about August 3, the spillway weir in spill bay 4 will be removed. The spillway weir in spill bay 20 will remain in place. The project will return to the 2008 summer spill pattern. Spill schedule and configuration will be determined in coordination with FFDRWG and TMT. The spill schedule will consider fish passage, power system needs, and changing flow conditions.

### **Operational Considerations:**

- Spillway weir 1 (relocated from spill bay 19) is located in spill bay 4. Spillway weir 2 remains in spill bay 20.
- 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 during any given spill treatment.
- Spill will be curtailed as needed to allow safe operation of fish transportation barges near collection facilities downstream of the project. Spill changes will be minimized in order to reduce effects on spill research. Specifically, the spillway, including spillway weirs in spill bays 4 and 20, will be closed while barges are crossing the tailrace (15 – 30 minutes per crossing). Gate hoists at spill bays 4 and 20 are modified to allow closure with spillway weirs in place.
- Minimum generation: A minimum powerhouse discharge of 50 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 50 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 50 kcfs for all hours.
- If total river discharge drops below about 90 kcfs, 40% spill treatments may be reduced to maintain 50 kcfs powerhouse discharge for minimum generation. Similarly, if total river discharge drops below about 135 kcfs, 60% spill treatments may be reduced to maintain a 50 kcfs powerhouse discharge.
- Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.
- 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.

### **John Day**

**Summer Spill Operations July 1 – August 31, 2009:** 30% or 40% spill 24 hours per day, then 30% spill 24 hours per day after the summer test. See Table A for operational spill levels.

### **Changes in Operations for Research Purposes:**

- Spill duration for testing: Approximately early June to July 20. 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.
- Summer research operations: If planned abatement measures are successful at reducing avian predation in the tailrace of John Day Dam, a repeat of the 2008 spillway weir test will be conducted. Two training spill percentages, 30% and 40% 24 hours per day, will be tested. If avian predation in the tailrace is at an unacceptably high level, to be determined during a May 21 SRWG meeting, spill will revert to the 2008 FPP summer pattern which is 30%, 24 hours per day. The two spillway weirs will be shut off to accommodate this, and a north bulked pattern will use spill bays 1-14.
- 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 fall Chinook.
- Spill pattern during the 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. From approximately early June to July 20, 30% spill versus 40% spill will be evaluated. Pending the outcome of the May 21 SRWG meeting, either spill patterns described in the 2008 FPP or the 30% spillway weir pattern will be used from the conclusion of the spillway weir test to the end of spill (approximately July 20 – August 31).

### **Operational Considerations:**

- Wire lines in the avian wire array across the tailrace need to be replaced. A full spillway outage is required to accomplish the work. The Corps is coordinating with the region to stop spill during daylight hours for one or more days to repair the array. The outage is being considered for early June between spring and summer fish outmigration periods, and prior to the start of the summer spillway weir test.
- Minimum spill: During periods of low flow before the spring freshet and during the summer period, there may be periods where spill quantities are limited so that tailrace conditions are not advantageous to fish passage. If such a low flow condition occurs, alternative operations at the dam will be coordinated through the TMT.
- Minimum generation: A minimum powerhouse discharge of 50 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 50 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 50 kcfs for all hours.
- 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.

- Unit outages and spill outages may be required to repair research equipment. These will be coordinated through FPOM and TMT.
- If river flows drop below about 75 kcfs then spill may need to drop below 30% spill in order to maintain station service and power system needs.

### The Dalles

**Summer Spill Operations July 1 – August 31, 2009:** 40% spill 24 hours per day. See Table A for operational spill levels.

#### **Changes in Operations for Research Purposes:**

- Spill pattern during the biological test: No research is planned for 2009. The FPP spill patterns will be used.

#### **Operational Considerations:**

- When high river flows are such that available spill bays 1 – 6 cannot maintain 40% spill (when spill exceeds 162 kcfs), FPOM and TMT will discuss the preferred spill pattern and rate. The project may maintain 40% spill of the total river flow and depart from the spill pattern, or spill less than 40% of the total river flow using a pattern other than that shown in the FPP.
- Spill bays 10, 11, 13, 16, 18, and 19 are not operational due to wire rope and structural concerns. Spill bay 23 has undercutting issues but may be used during high flows.
- The spill pattern in the FPP is based on a nominal Bonneville forebay elevation of 74 feet.
- Minimum generation: A minimum powerhouse discharge of 50 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 50 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 50 kcfs for all hours.
- 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.
- If river flows drop 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 21 through August 31, 2009:** Spill 85 kcfs during daytime hours from June 21 through July 20, then spill 75 kcfs during daytime hours from July 21 through August 31. Spill to the 120%/115% TDG spill cap at night. Daytime spill hours change periodically and are defined in FPP Table BON-6. It takes

approximately 10 minutes to change between day and night summer spill levels. See Table A for operational spill levels.

### **Changes in Operations for Research Purposes:**

- Spill duration for testing: No special spill operations are required in 2009. Spill patterns and durations from the FPP will be used.
- Summer research operations: No special spill operations are required for 2009 biological tests.
- Objectives of the biological test: Estimate juvenile subyearling Chinook passage distribution in response to a behavioral guidance structure at Powerhouse 2.
- Spill Patterns for summer operations: Spill patterns in the FPP will be used.

### **Operational Considerations:**

- **Minimum generation**: A minimum powerhouse discharge of 30 kcfs is required at all times to meet minimum generation requirements. The lower Columbia River dams provide some of the required generation capacity reserves for the power system. Due to this requirement and the constant fluctuations in power demands throughout the day, the 30 kcfs flow cannot be maintained precisely on an hourly basis. The flow may increase by as much as 10 kcfs for short periods. Therefore, the minimum generation flow should meet or exceed 30 kcfs for all hours.
- **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.
- Turbine unit and corner collector outages may be required to repair hydrophones and other research equipment. These will be coordinated through FPOM.
- Minimum spill discharge level is 50 kcfs. This is to provide acceptable juvenile fish egress conditions in the tailrace.
- Actual spill levels at Bonneville Dam may range from 1 to 3 kcfs lower or higher than specified Table A. 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, 2009.
- A mid-season spillway outage will be required to survey the stilling basin for erosion. Pending the outcome of this survey, the 2009 spill operation may be altered to maintain dam safety. Changes to spill operations may include changing the spill pattern to avoid further erosion or discontinuing spill until repairs can be made. The mid-season survey will take approximately ½ day to complete. The Corps will coordinate this work through the Fish Facility Design Review Work Group (FFDRWG), FPOM, and TMT.

## **JUVENILE FISH TRANSPORTATION PROGRAM OPERATIONS**

As noted above, the Corps' planned spill operations assume average runoff conditions. The following explains the juvenile fish transportation program under all runoff conditions and is consistent with the 2008 transport operations. The lower Snake River projects are described first, followed by McNary project operations. Detailed descriptions of project and transport facility operations to implement the program, including the transition from barges to trucks when fish numbers decrease in the summer, and the end dates for transport, are contained in FPP Appendix B.

### **Lower Snake River Dams - Operation and Timing**

The 2009 Spring FOP provides information about the initiation of transport at the lower Snake River collector projects; however, the Snake River projected seasonal average (April 3 – June 20) flows were greater than 70 kcfs and the Corps initiated transportation on a staggered start basis. Dates to begin transport at the lower Snake River collector projects were coordinated through TMT.

The collection of fish for transport began at Lower Granite Dam on May 1 at 0700 hours. It began 4 days later at Little Goose Dam, on May 5 at 0700 hours; and began 3 days after that at Lower Monumental, on May 8 at 0800 hours. Barging of fish began the following day and will continue with collected juvenile fish barged from each facility on a daily or every-other-day basis (depending on the number of fish) throughout the spring and into the summer. Starting on or about August 15, fish will be transported by truck, pending 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**

Juvenile fish collected at McNary between April and the start of transport will be bypassed to the river. The normal operation is 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 are routed through the separator, interrogated for PIT tags, and then bypassed to the river.

Transportation will be initiated at McNary Dam during July 15 – 30, 2009 as per the 2008 BiOp (RPA 30, Table 4) and in coordination with NOAA Fisheries and 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, 2009. 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 the TMT coordination process.

## **TRANSPORT, LATENT MORTALITY, AND AVIAN RESEARCH**

Spring operations to conduct research on the seasonal effects of transport and latent mortality are described in the 2009 Spring FOP. The avian predation study continues into the summer and is described below.

### **Avian Predation**

A study is being conducted to evaluate the impacts of avian predation on salmonid smolts from the Columbia and Snake rivers. The study will determine how various biotic and abiotic factors are associated with differences in steelhead smolt vulnerability to predation by Crescent Island terns and Foundation Island cormorants. The study requests PIT tagging both hatchery and wild steelhead collected in the smolt monitoring sample at Lower Monumental and Ice Harbor dams, beginning April 1 and continuing through July. The recorded condition of a fish will be attached to a specific tag code and vulnerability to avian predation will be evaluated using PIT tag recovery data collected from the avian bird colonies. The study needs a minimum sample of 100 fish each day that are collected for condition by the smolt monitoring program.

## **EMERGENCY PROTOCOLS**

The Corps and the Bureau of Reclamation will operate the projects in emergency situations in accordance with the WMP Emergency Protocols (WMP Appendix 1). The Protocols define emergency conditions and situations that may arise while operating the FCRPS projects, and the immediate actions that may be taken in the face of the emergency. The most recent version of the Emergency Protocols is located at: <http://www.nwd-wc.usace.army.mil/tmt/documents/wmp/2009/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, FPOM, and FFDRWG.

## **REPORTING**

The Corps will provide periodic in-season updates to TMT members on the implementation of 2009 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/](http://www.nwd-wc.usace.army.mil/ftppub/water_quality/12hr/html/)