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2024 Fish Operations Plan

1. INTRODUCTION

The 2024 Fish Operations Plan (2024 FOP) describes the U.S. Army Corps of Engineers' (Corps) planned operations for fish¹ passage at its four lower Snake River and four lower Columbia River dams during the 2024 surface spill operations in March through early April, spring, and summer fish migration seasons, generally April 3 through August 31, and surface spill operations September through mid-November. The 2024 FOP is consistent with spill operations for fish passage and the regional forum process for adaptive management and in-season management provisions outlined in the Record of Decision for the Columbia River System Operations Environmental Impact Statement (CRSO EIS ROD) dated September 28, 2020, CRSO Final EIS, 2020 National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS) Columbia River System (CRS) Biological Opinions (2020 CRS BiOps)², the Extensions of the 2008 Columbia Basin Fish Accords (Accord Extensions), the Corps' requirements under the Endangered Species Act (ESA), and the ongoing consultation and communications with the relevant wildlife agencies to ensure consistency with the Act. The 2024 FOP also incorporates operations outlined in Appendix B of the "U.S. Government Commitments in Support of the Columbia Basin Restoration Initiative" (USG Commitments). The USG Commitments were agreed to as part of the 2023 Memorandum of Understanding. Other project operations and water management actions not specifically addressed in this document will be consistent with other guiding operative documents, including the 2024 Water Management Plan (WMP), seasonal WMP updates, and the 2024 Fish Passage Plan (FPP).

In addition to discussing project-specific fish passage spill operations, the 2024 FOP identifies factors that the Corps, the Bureau of Reclamation (Reclamation), and the Bonneville Power Administration (Bonneville) (collectively referred to as the "Action Agencies") must address in the context of operating this complex system of fourteen multiple purpose projects. The 2024 FOP includes a discussion of how the Corps manages fish passage spill and total dissolved gas (TDG), identifies Planned and Routine Operational Adjustments (Section 4) that influence fish passage spill, addresses adaptive management and in-season management processes for fish passage spill and other fish operations including the juvenile fish transportation program, and describes the Corps' monthly implementation reports.

¹ ESA-listed salmon and steelhead.

² The Corps, in coordination with the other Action Agencies, and NMFS, employs the Regional Implementation Oversight Group (RIOG) and technical teams including the Technical Management Team (TMT) and Fish Passage Operations & Maintenance (FPOM) coordination group, to coordinate with state, tribal and other federal experts for recommendations for implementing operations consistent with the 2020 BiOps.

2. MANAGEMENT OF SPILL FOR FISH PASSAGE AND TDG

2.1. State Water Quality Standards for TDG

The Corps will manage spill for fish passage in 2024 consistent with the State of Washington and the State of Oregon total dissolved gas (TDG) water quality standards (WQS).^{3,4} The State of Washington, Department of Ecology (WADOE) adopted a WQS rule change which became effective in 2020 allowing spring juvenile fish passage spill operations to generate specified TDG levels in project tailraces (up to 125% TDG 12 hours, 126% TDG 2 hours), so long as the specified conditions are met, including that spring juvenile fish passage spill operations do not exceed the spill levels and durations reviewed in applicable ESA consultation documents. The Environmental Protection Agency (EPA) subsequently approved the rule change and found that the ESA consultation documents ensure that any spring spill regime using the revised criteria must be performed in accordance with the spill levels and durations evaluated in ESA consultation documents for effects to ESA-listed species of all life stages, including juvenile out-migrating salmonids, resident salmonids, and adult migrating salmonids. EPA's approval of the rule further states that "compliance with the ESA consultation documents is a condition precedent for the revised criteria and so the criteria are not applicable for the purposes of the [Clean Water Act (CWA)] (i.e., have no effect for CWA purposes) without the ESA consultation documents addressing spill operations that result in TDG saturation levels above the pre-existing criterion." *Letter to WADOE from EPA Re: The EPA's Action on Revisions to the [WADOE's] Surface Water Quality Standards for the Site-Specific Total Dissolved Gas Criteria in the Columbia and Snake Rivers, and Other Water Quality Standards Revisions* dated March 5, 2020, page 9.

The State of Oregon, through its Environmental Quality Commission, approved a modification to its TDG WQS (up to 125% TDG 12 hours, 127% TDG 2 hours), so long as spring spill is "applied in a manner consistent with the applicable requirements of the federal [ESA]." *Order Approving a Modification to the Oregon's Water Quality Standard for Total Dissolved Gas in the Columbia River Mainstem* dated February 11, 2020, page 4. Regarding Oregon's 105% TDG criterion, Oregon Department of Environmental Quality (ODEQ) clarified that this criterion does not apply to the Columbia River per their 29 January 2024 letter. Both states have thus accommodated levels of TDG above 110% for fish passage spill operations for ESA-listed juvenile salmonids at Corps projects on the lower Snake and lower Columbia rivers, as follows:

³ WASH. ADMIN. CODE § 173-201A-200(l)(f) provides the maximum TDG criteria for each of the aquatic life use categories and displays Table 200 (l)(f) that states: "Total dissolved gas shall not exceed 110 percent of saturation at any point of sample collection." The code also addresses exceptions and adjustments, including a provision allowing for an adjustment of the TDG criteria to aid fish passage over hydroelectric dams. See <https://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A-200>.

⁴ OR. ADMIN. R. 340-041-0031 provides in part: "the concentration of TDG relative to atmospheric pressure at the point of sample collection may not exceed 110 percent of saturation." OR. ADMIN. R. 340-041-104(3) identifies findings the Environmental Quality Commission must make for the purpose of allowing increased spill for salmon migration. See <https://www.oregon.gov/deq/wq/Documents/columbiaUSACEtmdlorder.pdf>

Washington Administrative Code:

WAC 173-201A-200(1)(f)(ii) and WAC 173-201A-200(1)(f)(ii)(A)

(ii) The TDG criteria may be adjusted to aid fish passage over hydroelectric dams that spill for anadromous juvenile fish as of the 2020 spill season. The elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. The following special fish passage exemptions for the Snake and Columbia Rivers apply when spilling water at dams is necessary to aid fish passage:

(A) TDG must not exceed:

- An average of 115 percent as measured in the forebays of the next downstream dams and must not exceed an average of 120 percent as measured in the tailraces of each dam (these averages are calculated as an average of the 12 highest hourly readings in a calendar day, relative to atmospheric pressure); and
- A maximum TDG saturation level of 125 percent calculated as an average of the two highest hourly TDG measures in a calendar day during spillage for fish passage.

WAC 173-201A-200(1)(f)(ii)(B)

(B) To further aid fish passage during the spring spill season (generally from April through June), spill may be increased up to the following levels as measured at the tailrace fixed site monitoring location:

- A maximum TDG saturation level of 125 percent calculated as an average of the 12 highest hourly TDG measures in a calendar day: and
- A maximum TDG saturation level of 126 percent calculated as an average of any two-consecutive hourly TDG measures. These TDG criteria may be applied in place of (f)(ii)(A) of this subsection during spring spill operations when applied in accordance with the following conditions:

(I) In addition to complying with the requirements of this chapter, the tailrace maximum TDG criteria at hydropower dams shall be applied in accordance with Endangered Species Act consultation documents associated with spill operations on the Snake and Columbia rivers, including operations for fish passage. The Endangered Species Act consultation documents are those by which dams may legally operate during the time that the adjusted criteria in (f)(ii)(B) of this subsection are in use.

(II) Application of the tailrace maximum TDG criteria must be accompanied by a department approved biological monitoring plan designed to measure impacts of fish exposed to increased TDG conditions throughout the spring spill season. Beginning in the year 2021, plans must include monitoring for non-salmonid fish species and must continue for a minimum of five years, and thereafter as determined by the department.

(III) TDG must be reduced to allowances specified in (f)(ii)(A) of this subsection if the calculated incidence of gas bubble trauma in salmonids (with a minimum sample size of

50 fish required weekly) or non-salmonids (with a minimum sample size of 50 fish required weekly) exceeds:

- Gas bubble trauma in non-paired fins of 15 percent; or
- Gas bubble trauma in non-paired fins of five percent and gas bubbles occlude more than 25 percent of the surface area of the fin.

If gas bubble trauma exceeds these biological thresholds, additional monitoring must demonstrate the incidence of gas bubble trauma below biological thresholds before TDG can be adjusted to allowances specified in this subsection. Gas bubble trauma monitoring data shall be excluded from comparison to biological thresholds when higher than normal river flow contributes to excess spill above the ability to meet (f)(ii)(B) of this subsection. This monitoring data exclusion shall apply for one full calendar day after reduced river flow allows attainment of (f)(ii)(B) of this subsection.

Oregon Water Quality Standard Modification:

The Environmental Quality Commission approves the following modification to the statewide standard for total dissolved gas (OAR 340-41-0031(2)) of 110 percent for the lower Columbia River at McNary, John Day, The Dalles and Bonneville dams, as provided for in OAR 340-41-0104(3):

1. The total dissolved gas standard for the Columbia River as measured in the tailraces of McNary, John Day, The Dalles, and Bonneville dams is 125 percent for the period from April 1 through June 15.⁵
2. The total dissolved gas standard for the Columbia River as measured in the tailraces of McNary, John Day, The Dalles, and Bonneville dams is 120 percent for the period from June 16 through August 31.
3. These limits do not apply when the stream flow exceeds the seven-day, ten-year frequency flood.
4. The DEQ Director may approve additional periods of application of this modification, beyond the April 1 to August 31 period, subject to subsections 7.a) to 7.d) for reasons including passing Spring Creek Hatchery fish releases, maintenance activities, and biological or physical studies of spillway structures and prototype fish passage devices. The Corps must notify DEQ in writing describing the proposed action, the purpose of the action and dates of action at least one week prior to the spill. The Corps must obtain written approval from the Director prior to such spill.
5. The modified total dissolved gas standards will apply for five years, 2020, 2021, 2022, 2023 and 2024.

⁵ ODEQ has extended the modification to begin on March 1, 2024.

6. Voluntary fish passage spill during the spring spill season, occurring from April 1 through June 15, is subject to the following conditions:

a) Spill at a dam must be reduced when:

i. Instantaneous total dissolved gas levels exceed 127 percent of saturation, calculated as the average of any two-consecutive hourly TDG measurements in the tailrace of the dam; or

ii. The average of the twelve highest hourly TDG measurements in the tailrace of the dam in a calendar day exceeds 125 percent.

b) Spill at a dam must be reduced to 120 percent as calculated in 7.a) i. when:

i. The calculated incidence of gas bubble trauma in salmonids (with a minimum sample size of fifty fish required weekly) or non-salmonids (with a minimum sample size of fifty fish required weekly) exceeds gas bubble trauma in non-paired fins of fifteen percent, or gas bubble trauma in non-paired fins of five percent and gas bubbles occlude more than twenty-five percent of the surface area of the fin. If gas bubble trauma exceeds these biological thresholds, additional monitoring must demonstrate the incidence of gas bubble trauma below biological thresholds before TDG can be increased to the level specified in this order. Gas bubble trauma monitoring data shall be excluded from comparison to biological thresholds when higher than normal river flow contributes to excess spill above 125 percent. This monitoring data exclusion shall apply for one full calendar day after reduced river flow allows attainment of 125 percent TDG levels in the tailrace of the dam.

c) The tailrace maximum TDG criteria for spring spill in this modification will be applied in a manner consistent with the applicable requirements of the federal Endangered Species Act.

d) Physical monitoring must occur and be adequate for implementing the requirements of this order.

e) Application of the tailrace maximum TDG criteria must be accompanied by a DEQ-approved biological monitoring plan designed to measure impacts to fish exposed to increased TDG conditions throughout the spring spill season. Beginning in the year 2021, plans must include monitoring for non-salmonid fish species. Gas bubble trauma monitoring for juvenile salmonids may be halted if there is a high mortality risk due to compounded effects of the evaluation procedure and adverse environmental factors such as high stream temperatures.

7. Voluntary fish passage spill during the summer spill season, occurring from June 16 through Aug. 31, is subject to the following conditions:

a) Spill at a dam must be reduced when:

- i. The average of the twelve highest hourly TDG measurements in the tailrace of the dam in a calendar day exceeds 120 percent of saturation; or
 - ii. Instantaneous total dissolved gas levels exceed 125 percent of saturation in the tailrace of the dam, calculated as the average of the two highest hourly total dissolved gas measures in a calendar day.
- b) The DEQ Director may halt the voluntary spill program or require reductions in voluntary spill to reduce TDG levels if voluntary spill results in biological threshold exceedances when:
 - i. More than 15 percent of salmonids examined show signs of gas bubble disease in their non-paired fins, or
 - ii. More than five percent of salmonids examined show signs of gas bubble trauma in their non-paired fins where more than 25 percent of the surface area of the fin is occluded by gas bubbles.
- c) Physical monitoring must occur and be adequate for implementing the requirements set out in this order.
- d) Application of the tailrace maximum TDG criteria must be accompanied by a DEQ-approved biological monitoring plan designed to measure impacts to fish exposed to increased TDG conditions throughout the summer spill season. Beginning in the year 2021, plans must include monitoring for non-salmonid fish species. Gas bubble trauma monitoring for juvenile salmonids may be halted if there is a high mortality risk due to compounded effects of the evaluation procedure and adverse environmental factors such as high stream temperatures.

For the purposes of Oregon’s Order, ODEQ defines non-salmonid as including non-native species per their 10 June 2022 letter and 18 January 2023 email. Gas bubble trauma monitoring in bi-state waters will include evaluation of non-native species in the population of non-salmonids to comply with Oregon’s Order. WADOE’s Rule Implementation Plan is unchanged and continues to require GBT evaluation of native non-salmonids.

The terminology that has been adopted to refer to the States’ TDG Water Quality Standards (WQS) is the “gas cap.” Gas cap spill is spill to the maximum level that meets, but does not exceed, the TDG criteria allowed under state law. In its implementation of spill for fish passage, the Corps will operate its fish passage projects in 2024 to the spill levels identified in the CRSO EIS ROD, 2020 CRS BiOps, and Appendix B of the USG Commitments as extended and modified, and in accordance with the States’ TDG standards described above, including applying the different state calculation methodologies. When the standards vary or conflict, the Corps will apply the more stringent standard.

2.2. Spill Caps

The Corps’ Reservoir Control Center (RCC) is responsible for daily management of spill operations responsive to changing conditions to manage TDG within all applicable State

standards. To accomplish this, the RCC determines “spill caps” for each of the Corps’ lower Columbia and lower Snake River projects daily throughout the fish passage spill season. Spill caps are the maximum spill level at each project that is estimated to meet, but not exceed, the gas cap.

To calculate spill caps, the Corps evaluates observed and forecasted variables that influence TDG levels, including: (1) environmental conditions (e.g., total flow, wind, ambient temperature, barometric pressure, and incoming TDG from upstream); and (2) project operations (e.g., spill level, spill pattern, tailwater elevation, proportion of flow through the turbines, and project configuration).

During spill for fish passage, the Corps reviews spill caps daily and adjusts as necessary to define the maximum spill level that maintains TDG within applicable State standards. Additional information about how the Corps will manage TDG is described in the 2024 Water Management Plan (see Appendix 4: TDG Management Plan)⁶.

Higher spill than the target spill levels identified in Tables 3, 4, and 5 may occur due to high river flow that exceeds powerhouse hydraulic capacity or due to a lack of power demand (load). During periods when spill is greater than the spill cap due to lack of load conditions, the Corps manages excess TDG on a system-wide basis by incrementally increasing spill at projects throughout the system in the order of priority defined in the Spill Priority List⁷. For this purpose, the RCC also defines spill rates to target multiple TDG levels in project tailraces that exceed the gas cap. The order of priority is coordinated with regional sovereigns in the Technical Management Team (TMT) to allocate spill to projects to best manage system TDG while also considering how best to protect fish and other aquatic biota.

3. SPILLWAY OPERATIONS AND SPILL LEVEL PRECISION

The Corps plans to achieve the target spill levels defined in Tables 3, 4, and 5 to the extent feasible; however, actual hourly spill levels at each dam may vary depending on the precision of the spillbay gate settings, real-time fluctuations in flow and/or project head, or automatic load following. At each project, spill is distributed across the spillway according to patterns defined in the project-specific chapters of the FPP⁸ to provide favorable fish passage conditions.

Spillbay gates are opened to the settings identified in the FPP spill pattern table that correspond to the spill level that is closest to the target but may be slightly higher or lower than the target spill level. Due to these physical limitations in spill level precision, the observed hourly average spill level may vary ± 2 kcfs when the target spill is a flow rate (e.g., kcfs) and $\pm 1\%$ when the target spill is a percentage. Not all projects are able to achieve this level of precision (e.g. Little Goose and Bonneville dams). Additional flexibility for balancing reserves ($\pm 5\%$) could occur at John Day Dam (spring and summer) and The Dalles Dam (summer) as identified in Appendix B

⁶ The Water Management Plan (WMP) and associated appendices are updated annually. See <http://pweb.crohms.org/tmt/documents/wmp/>.

⁷ <http://pweb.crohms.org/tmt/documents/spill-priority/>

⁸ The FPP is coordinated annually with regional sovereigns through the FPOM. See <http://pweb.crohms.org/tmt/documents/fpp/>.

of the USG Commitments. More information regarding project specific spill precision limitations may be found in Section 9 below.

Snake River projects make spillbay gate setting changes as soon as feasible in response to target spill changes; however, there may be instances when spill level changes are delayed by up to 1 hour or more due to operation of the navigation locks.

4. MODIFICATIONS TO PLANNED OPERATIONS AND IN-SEASON MANAGEMENT

For planning purposes, the operations described in the 2024 FOP assume average runoff conditions. Actual runoff varies in magnitude and timing and observed river flow may be higher or lower than average at any time such that modifications to the planned operations may be required. To accommodate these varying runoff conditions and other routinely observed conditions as they arise, the Corps, in conjunction with the other Action Agencies, NMFS, and USFWS, coordinates with regional sovereigns on these conditions and other planned operations through the review of the 2024 FOP prior to spring spill operations (see section 4.1). The Corps responds in real-time to these routine conditions and planned operations by implementing adjustments as conditions require without additional coordination.

For unanticipated and unplanned conditions that are not pre-coordinated, the Corps responds as necessary to adjust to the condition, and when possible, will use the existing regional coordination process⁹ to adaptively manage and make necessary in-season adjustments in spill and other fish operations (e.g., spill levels, spill caps, spill patterns, juvenile fish transportation, and pool operating ranges).

4.1. Conditions that May Require Adjustments to Planned Operations

Under certain conditions or circumstances, the Corps may be required to adjust spill higher or lower than the target spill level at one or more projects.

Planned and Routine Operational Adjustments:¹⁰

1. High flow conditions that exceed powerhouse hydraulic capacity and require spilling more than the target spill level.

⁹ In-season adaptive management changes in spill levels could include adjustments that address unintended biological consequences caused by spill (e.g., adult passage delays), for the juvenile fish transportation program, for research activities for studies to evaluate fish passage facilities, survival, or other fish-related issues. Spill patterns and biological testing protocols that have not been coordinated to-date will be considered through the regional coordination process using Regional Forum subcommittees, which include the TMT, Studies Review Workgroup (SRWG), Fish Facility Design Review Work Group (FFDRWG), and FPOM.

¹⁰ Planned and Routine Operational Adjustments are spill adjustments due to (1) conditions that occur routinely every year (e.g., high or low flow), or (2) planned operations (e.g., scheduled maintenance, transit of fish transport barge in the tailrace). These are considered pre-coordinated through regional sovereign review of the FOP and the FPP and are implemented by the Action Agencies as conditions require and without additional coordination through the regional forum processes. Spill adjustments due to routine or planned operations are included in the monthly FOP Implementation Report in the hourly spill and flow charts (plots), and conditions with an (*) are reported in the “Pre-Coordinated Operations” Table. The FPP (Appendix A) identifies actions with pre-coordinated dates.

2. Low flow conditions that require adjustments in spill level while maintaining project minimum generation requirements (see section 4.3.1. below).
3. Lack of power demand (load) resulting in increased spill.
4. Operational limitations, for example physical limitations of gate settings, spill patterns (see section 3), forebay elevation, and deadband¹¹.
5. Scheduled turbine unit and/or transmission outages that reduce powerhouse hydraulic capacity and require spilling more than the target spill level.* (see footnote 10)
6. Standard operations for transmission reliability (see section 4.4.1. below).*(see footnote 10)
7. Navigation safety concerns (see section 4.6. below).*(see footnote 10)
8. Transition periods between gas cap spill and performance standard spill blocks¹² spill hours may result in actual hourly spill levels that are slightly higher or lower than targeted spill levels.

Non-routine or Unplanned Operational Adjustments:¹³

1. Contingency operations for transmission reliability (see section 4.4.2 below).
2. Fish emergencies (e.g., high river temperatures that exceed levels safe for fish, adult fish passage blockages, actionable incidence of gas bubble trauma (GBT) incidence rates in either juvenile salmonids or non-salmonids¹⁴, etc.).
3. Conditions related to project safety (e.g., erosion), health and human safety, navigation, or other unforeseen events that require spilling more or less than the target spill level.¹⁵
4. Other circumstances including human or programming error, unscheduled maintenance or outage, and other unanticipated events or emergencies.
5. In-season adjustments following adaptive management coordination through the existing regional coordination process (see section 4).

¹¹ Deadbands occur when turbine outflow cannot achieve some flow ranges. When targeting spill as a percent of outflow, these deadbands will result in a spill percentage that is above or below the target percentage at certain outflows.

¹² “Performance standard” spill is a NMFS term and refers to spill levels intended to meet NMFS’ performance standard testing, as described in the 2008 Biological Opinion and accompanying administrative record.

¹³ Spill adjustments that occur due to non-routine or unplanned conditions or operations are implemented by the Action Agencies as conditions require and/or as coordinated with regional sovereigns through the in-season adaptive management process. Non-routine or Unplanned Operational Adjustments that affect spill levels are reported in the FOP Implementation Report Variance Table (and when warranted, a description may also be included in the Operational Adjustments section). When a Non-routine or Unplanned Operational Adjustment does not affect spill levels, information about this is provided in the Operational Adjustments section. If an adjustment continues into the next month, the adjustment is reported in the Pre-Coordinated Operations Table.

¹⁴ See WAC 173-201A-200(1)(f)(ii)(B)(III), including WADOE’s Rule Implementation Plan for Chapter 173-201A WAC Water Quality Standards for Surface Waters of the State of Washington (Publication 19-10-048; pages 7-9), and Order Approving a Modification to the Oregon’s Water Quality Standard for Total Dissolved Gas in the Columbia River Mainstem, page 5, including clarifications from Oregon Department of Environmental Quality email dated 18 January 2023, RE: Request for Clarification of Spring Non-Salmonid Monitoring Requirement.

¹⁵ When a generator requires repair, ongoing operations may require modification to prepare a turbine unit for the necessary maintenance without further damaging infrastructure or jeopardizing personnel safety. To safely install taillogs in a unit adjacent to the spillway, it may be necessary to cease spill through some spillbays for up to 6 or more hours during the installation of the physical barriers to isolate the area and subsequently dewater the draft tube environment. An alternate spill pattern for use during the maintenance period using the remaining spillbays will be coordinated through FPOM.

4.2. TMT Emergency Protocols

The Corps and the other Action Agencies operate the fourteen Columbia River System projects in emergency situations in accordance with the 2024 WMP Emergency Protocol (WMP Appendix 1). This protocol identifies the process the Action Agencies, in coordination with NMFS and USFWS, use in the event of an emergency concerning project operations that impact planned fish protection measures. The emergency protocols also address the process for coordination with regional sovereigns.

The most recent version of the Emergency Protocols is located at:

https://pweb.crohms.org/tmt/documents/wmp/2024/Appendices/Appendix_1_Emergency_Protocols_February_25_2022_with-ATTACHMENT-1%20clean_2.pdf

4.3. Low Flow Operations

4.3.1. Minimum Generation

All lower Snake and lower Columbia River dams have a minimum generation requirement that has been established to support power system reliability (see section 4.4.). The Corps has identified minimum generation powerhouse outflow values derived from the lower limit of the $\pm 1\%$ peak efficiency operating range defined in the project-specific chapters of the FPP and from actual generation records (see Table 1). Values stated in Table 1 are approximate ranges that account for varying head or other small adjustments in turbine unit operation that may result in variations from the reported minimum generation flow and spill amount. Conditions that may result in minor variations include:

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

All of the lower Snake River powerhouses may be required to keep one generating unit¹⁶ online at all times for power system reliability under low river flow conditions, which may result in a reduction of spill at that project if there is insufficient flow in the river. Generally, units 1–3 are the priority units for operation during the fish passage season for adult fish attraction flow to the fish ladders, but unit priority is also based on availability. During low river flow conditions, the

¹⁶ Two generating units may be necessary at Ice Harbor Dam during elevated air temperatures to meet transmission requirements.

Corps operates the lower Snake River and lower Columbia River projects to the unit priority order specified in the FPP and minimum generation ranges identified in Table 1.

Table 1.— Minimum generation flow ranges (kcfs) for turbine units at Corps hydropower projects on the lower Snake and lower Columbia rivers.¹⁷

Project	Turbine Unit	Minimum Generation Flow Range ^A (kcfs)
Lower Granite	1, 3	11.6 – 12.7
	2 ^B	17.8 – 18.8
	4, 5, 6	13.8 – 14.9
Little Goose	1, 2, 3	11.8 – 12.3
	4, 5, 6	14.3 – 14.9
Lower Monumental	1, 2, 3	11.7 – 12.9
	4, 5, 6	13.8 – 14.6
Ice Harbor	1 ^C	Out of service
	2	12.1 – 14.1
	3	8.6 – 10.3
	4 ^B	12.2 – 13.5
	5, 6 ^B	12.5 – 14.1
McNary	N/A	50 – 60 (may increase up to 80 for reserves) ^D
John Day	N/A	50 – 60 (may increase up to 80 for reserves) ^D
The Dalles	N/A	50 – 60
Bonneville	N/A	30 – 40 (may increase to 60 for reserves) ^D

A. “Minimum Generation” is the minimum number of megawatts (MW) that must be generated at each project to support power system reliability. This table defines the resulting flow range (kcfs) through turbines, which is a function of power output (MW), turbine efficiency, and project head.

B. Lower Granite Unit 2, and Ice Harbor Units 4, 5, and 6 are restricted due to runner blades that are set at a fixed angle (non-adjustable). If a unit is restored to an adjustable-blade Kaplan in-season, the minimum generation range will revert to the lower 1% limit. Also, Ice Harbor Unit 2 has a fixed-blade (non-adjustable) runner design.

C. Ice Harbor Unit 1 is being rebuilt with an adjustable-blade runner design that reduces impacts to fish, scheduled for completion in 2026. At that time, testing will be performed to confirm the operating range.

D. Minimum generation flow ranges are consistent with 2023 FOP operations. Powerhouse outflows may increase up to 80 kcfs at McNary and John Day dams and up to 60 kcfs at Bonneville Dam for reserves (without triggering reporting requirements described in Section 4.1). Increased powerhouse generation allowances will allow for additional generation for the purpose of providing real-time operators greater access to reserve capacity prior to requiring variance tracking or declarations of power system emergency. As needed, the higher ranges will be utilized for reserves under low flow conditions (e.g., minimum generation and spill the rest) and when flexibility elsewhere (e.g., Grand Coulee and Chief Joseph dams to carry and deploy reserves) has been maximized. Powerhouse flows exceeding 80 kcfs at McNary and John Day dams or 60 kcfs at Bonneville Dam for reserves within the Bonneville balancing authority area will be reported in the Pre-Coordinated Operations Table. Any other exceedances for reserves will be reported in the Variance Table in the monthly FOP Implementation Report (see section 10).

There may be situations when river flows are insufficient to maintain minimum generation in Table 1 and the target spill level identified in Tables 3, 4, and 5 every hour. Under these conditions, the lower Snake River projects operate one turbine unit at minimum generation and spill the remainder of outflow. The lower Columbia River projects also operate at minimum

¹⁷ The table is accurate as of March 2024 but may change in-season as coordinated through FPOM (see the FPP).

generation and pass the remaining outflow as spill down to minimum spill levels. Under low river flow conditions during spring spill operations, the Corps attempts to remain as close as possible to spill target levels for either gas cap spill or other spill percentages or volumes, depending on which operation is targeted for a given hour. The inability to meet the target gas cap spill level due to low river flow does not preclude the ability of the Corps to target spill levels for up to 8 hours a day as specified in Table 4. Additionally, inflow provided by non-Federal projects upstream is often variable and uncertain, and in combination with low flow conditions, may result in instances where forebay elevations go outside of the restricted operating ranges for Snake River and Columbia projects described in Section 4.6.¹⁸

4.3.2. Navigation Lock Operation During Low Flows

At projects that have a target spill level that is a percentage of total outflow, emptying the navigation lock during low flow conditions may temporarily result in a reduced percentage of outflow that is reported as spill. During this time, the spill rate remains constant, but the spill reported as a percent of total outflow may be temporarily reduced below the target 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 project outflow than during periods of higher flow.

4.4. Operations for Transmission System Reliability

In managing the fish passage spill operations, the Corps and Bonneville plan to allocate generation and spill at the eight Corps projects on the lower Columbia and Snake rivers in accordance with the 2024 FOP. Periodically, to ensure the reliability of the transmission system when system conditions warrant, it is necessary to increase or decrease the amount of water flowing through a project's turbines and spillbays at one or more of these projects.

Consistent with past practice, if any of the transmission system conditions listed below are present and can be alleviated by temporarily modifying generation levels at one or more federal projects, the Action Agencies adjust generation and spill levels to avoid the transmission system impact. These events could result in actual spill being temporarily higher or lower than the target fish passage spill level. Such events may occur coincident with the transmission system event or in subsequent hour(s) should the event impact water balance at a specific hydro project or river reach. The Corps and Bonneville work to restore conditions to support target spill operations as soon as practicable. These actions are taken to minimize the risk and/or scope of a transmission system emergency and are reported in the monthly FOP Implementation Report (see section 10 below).

4.4.1. Standard Operations for Transmission Reliability

Consistent with past practice, the Action Agencies manage the fourteen Columbia River System projects to be prepared to provide electric reliability support as follows:

¹⁸ Lower Snake River projects operate within the minimum operating pool (MOP) range during fish passage season (Table 2).

1. Ensuring sufficient range of generation capability is available to provide the Bonneville balancing authority¹⁹ area with contingency reserves required by North American Electric Reliability Corporation (NERC) reliability standards.²⁰
2. Ensuring generation is available to increase or decrease to balance load and generation within the Bonneville balancing authority area to support reliability.
3. Ensuring enough generating units are online and have sufficient capability to increase or decrease generation to meet the Bonneville balancing authority area frequency response obligations, consistent with reliability standard requirements.
4. Bonneville must first meet its reserve obligations for system reliability.²¹ When conditions result in an inability to meet the target spill levels defined in Tables 4 and 5, Bonneville will make best efforts to minimize the allocation of reserves (decremental, DEC and/or incremental, INC) on fish passage projects if a spill reduction would be required to allocate the reserves.
5. Ensuring that there is generation operating at projects in specific locations sufficient for arming for Remedial Action Schemes (RAS).²² RAS allow the transmission system to automatically respond to unplanned events on the power system by immediately dropping or reducing generation at those specified locations.
6. Maintaining minimum generation levels (see Table 1) at generators in specific locations to maintain correct voltage levels on the power system to ensure reliability.
7. Maintaining enough generation units online in diverse locations on the electrical grid to ensure system stability through rotating inertia.

4.4.2. Contingency Operations for Transmission Reliability

If the routine reliability tools described above are insufficient to resolve the transmission condition, the Action Agencies implement the preemptive actions detailed in the Power System Emergency Action Plan (Attachment 1 to the TMT Emergency Protocols referenced in section 4.2 above) if time permits. Where necessary, the fourteen Columbia River System projects will be called upon to relieve the following conditions:

1. Increasing or decreasing generation at projects (redispatch) in specific geographic locations to relieve heavily loaded transmission lines if required by system conditions. This includes adjusting generation that flows over specific transmission facilities to keep flows over those paths within the requirements of NERC reliability standards.
2. Increasing or decreasing generation to ensure transmission system stability and/or reliable load service in local areas under specific system conditions. For example, increasing

¹⁹ A balancing authority is the responsible entity that maintains load-interchange-generation balance within a Balancing Authority Area and supports interconnection frequency in real time. Balancing authority area is the collection of generation, transmission, and loads within the metered boundaries of the designated balancing authority. The balancing authority maintains load-resource balance within this area.

²⁰ The Federal Energy Regulatory Commission has certified the NERC as the Electric Reliability Organization responsible for establishing and enforcing national reliability standards.

²¹ For example, generators may be required to maintain generation levels above minimum generation to provide sufficient capability to reduce generation.

²² Remedial Action Schemes are sets of automatic control circuits that switch various types of power system components on or off in response to disturbances on the interconnected transmission system.

generation at Ice Harbor Dam to support transmission stability, including providing load service to the Tri-Cities area of Washington, when system conditions require.

3. Responding to unanticipated significant events, including NERC Energy Emergency Alerts or other system emergencies, consistent with the Power System Emergency Action Plan included as Attachment 1 to the TMT Emergency Protocols.
4. Other unanticipated significant events (e.g., fires, earthquakes, etc.).

These actions are implemented consistent with the TMT Emergency Protocols (see section 4.2 above).

4.5. Turbine Unit Testing for Maintenance

Turbine units may be operationally tested prior to maintenance and prior to return to service by running the unit at speed no load, various loads within the $\pm 1\%$ of peak efficiency range, and, if necessary, up to full load, to allow for measurements and testing. Testing of a unit under maintenance is in addition to a unit operating at minimum generation required for power system reliability. Testing may deviate from unit operating priorities specified in FPP Chapters 2-9 and may use water that would otherwise be used for spill if the unit operating for reliability is at the bottom of the $\pm 1\%$ of peak efficiency range. Water is used from the powerhouse outflow allocation if possible, and water diverted from spill for operational testing will be minimized. The Corps coordinates this testing with the region through FPOM. Unit outages for required maintenance are described in FPP Appendix A. Maintenance dates are subject to change.

4.6. Navigation Safety and Minimum Tailwater Elevations

Short-term adjustments in spill or minimum operating pool (MOP) elevations may be required at any of the fish passage projects to address navigation safety concerns.²³ This may include changes in spill patterns, reductions in spill, short-term spill curtailment, or operating above MOP. Adjustments to MOP may also be required to meet minimum tailwater elevations (Table 2). Current spill operations for fish passage result in complex downstream hydraulics that cause large fluctuations in tailwater elevations. The 2020 BiOps describe MOP at the lower Snake River projects as a 1.5-foot range above the minimum forebay elevation (Table 2). To clearly communicate the implementation of this operation, the term “MOP” will refer to the 1.5-foot operating range above the minimum forebay elevation at the lower Snake River projects (i.e., “MOP” is a 1.5-foot operating range).

The Corps will operate Lower Granite Dam at MOP with a 1.5-foot forebay operating range and a 1.0-foot range to the extent possible (referred to operationally as a “soft constraint”) from April 3 until August 31, unless adjusted on occasion to meet authorized project purposes, primarily navigation, except as noted below.²⁴ Little Goose, Lower Monumental and Ice Harbor dams will operate at MOP with a 1.5-foot forebay operating range and a 1.0-foot range soft constraint to

²³ The Corps conducts annual surveys to assess sedimentation in the reservoirs and under certain conditions. To ensure safe navigation, there may be a need to operate the pools above the MOP range.

²⁴ The Corps conducts a bathymetric survey of the federal navigation channel annually to assure a 14-foot depth is maintained in the federal navigation channel. With the dredging completed in winter 2022/2023, Lower Granite will operate in the normal MOP range (733.0-734.5 feet) from April 3 until August 31 (and within a 1.0-foot soft constraint range to the extent possible).

the extent possible from April 3 until August 14, unless adjusted on occasion to meet authorized project purposes, primarily navigation, except as noted below.

Table 2.— Normal and minimum operating pool (MOP) elevation ranges and minimum tailwater elevations for lower Snake River projects. ^A

Project	Normal Operating Elevation Range (ft) ^B		MOP Elevation Range (ft) ^C		Project Tailwater (ft)
	Minimum	Maximum	Minimum	Maximum	Minimum
Lower Granite	733.0	738.0	733.0	734.5	633.0
Little Goose	633.0	638.0	633.0	634.5	537.0
Lower Monumental	537.0	540.0	537.0	538.5	437.0
Ice Harbor	437.0	440.0	437.0	438.5	337.0

A. Elevations provided in feet above mean sea level (NGVD29).

B. August 15 – April 2, except at Lower Granite (September 1-April 2).

C. April 3 – August 14, except at Lower Granite (April 3 – August 31). Projects will be operated within a 1.0-foot range to the extent possible (referred to operationally as a “soft constraint”).

Potential in-season adjustments to MOP, if necessary, will be an expanded forebay operating range (Expanded MOP), raised minimum forebay elevation (Raised MOP), as described below.

Expanded MOP: If the 1.5-foot MOP range is insufficient to maintain navigation safety, the range is expanded (e.g., to 2 feet). For instance, some flow conditions may require a 2-foot forebay operating range at Ice Harbor to provide safe conditions for barge traffic at the navigation lock exit. These adjustments may be necessary for both commercial traffic and fish transport barges. Using Ice Harbor as an example, this type of adjustment would be described as “2-foot expanded MOP (437.0-439.0 feet)”. Additionally, large within day fluctuations between gas cap spill and spill percentages or prescribed volumes may cause operational challenges in meeting MOP and an expanded MOP may be necessary, especially when combined with restricted turbine units that are not able to operate in the full ± 1 percent range.

Raised MOP: If the minimum forebay elevation is insufficient to maintain navigation safety or meet project minimum tailwater elevations, the 1.5-foot MOP range is raised as necessary. Adjustments in MOP operations have been necessary at the lower Snake River projects, typically during lower flow conditions. For instance, low flows in combination with fish passage spill operations may impact reservoir elevations and cause dips below project minimum tailwater elevations or inadequate navigation depths. Using Little Goose as an example, this type of adjustment would be described as “1.5-foot raised MOP (634.5-636.0 feet)”.

Spill Adjustments: High spill levels may create unsafe hydraulic conditions for commercial, non-commercial, and fish transportation barges entering and exiting the tailrace and/or while moored at the fish transport loading facility. Under these conditions, spill may be reduced temporarily as necessary to maintain safe navigation conditions for commercial, non-commercial, or fish transportation barges, which may result in temporarily filling the pool above the MOP range, depending on river flow.

5. JUVENILE FISH TRANSPORTATION PROGRAM

The best available information will be considered in the Corps' implementation of the juvenile fish transportation program operations at the Snake River collector projects in 2024. Should regional sovereigns recommend adjustments in transportation start dates that differ from those stated herein, the Corps uses the existing regional adaptive management process to reconcile recommended operational adjustments.

The following describes the proposed transportation operations for the lower Snake River projects. Detailed descriptions of project and transport facility operations to implement the juvenile fish transportation program are contained in the FPP Appendix B.

5.1. Lower Snake River Dams – Transport Operation and Timing

Transportation will be initiated at Lower Granite, Little Goose and Lower Monumental dams on April 24 (collection starting on April 23) or as coordinated through the TMT and the RIOG but begin no later than May 1. Transport begins the following day after fish collection and collected juvenile fish will be transported from each facility on a daily or every-other-day basis (depending on the number of fish) throughout the migration season. Transportation of spring migrants ends on June 20. Truck transportation of summer migrants at Lower Granite and Little Goose resumes on August 1 with allowance for TMT adaptive management adjustments and continues through October 31. Transportation operations are carried out at each project in accordance with relevant FPP operating criteria. Transportation and spill operations may be adjusted due to research, conditions at fish collection facilities (e.g., overcrowding or temperature extremes), or through the adaptive management process with FPOM and/or TMT (e.g., to respond to expected environmental conditions, to respond to recent transport vs in-river research results, to better match juvenile outmigration, or to achieve/maintain spill targets).

5.2. Transport Research – Seasonal Effects of Transport

An ongoing annual study will be conducted again in 2024 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 15, with marking beginning on April 16.

Depending on the number of fish available, fish will be collected 1-3 days each week 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 are expected to be maintained similar to what would occur under normal transport operations at 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, 4,000-6,000 wild steelhead, and 4,000-6,000 hatchery steelhead weekly for approximately eight weeks.

6. FALL/WINTER SURFACE SPILL OPERATIONS

Surface spill operations in March–April and September–November (referred to in Appendix B of the USG Commitments Document as “Fall/Winter Spill Operations”) will occur during the dates and times defined below in Table 3.

Table 3.— Fall/Winter Surface Spill Operations. ^A

Project	Dates	Hours	Notes
LWG, LGS, LMN, IHR, MCN	March 1 – March 20	4 hours/day in the morning, 7 days/week	MCN SW in spillbay 20.
	March 21 – April 2 (Snake projects) or April 9 (MCN)	24 hours/day, 7 days/week	LGS SW in high crest (~7 kcfs).
	September 1 – November 15	4 hours/day in the morning, 7 days/week	
JDA	March 21 – April 9	24 hours/day, 7 days/week	Opening the SW requires a crew and crane and must be done during daylight hours. On March 21, an equivalent spill rate (~10 kcfs) will occur via the non-SW pattern from 0001 hours until the SW in spillbay 19 is opened in the morning as early as possible.
TDA Sluiceway	March 1 – December 15	24 hours/day, 7 days/week	TDA sluiceway is a non-spillway surface passage route. See FPP Chapter 3 for operating criteria.
BON B2CC	March 1–8	0600-1000 daily	BON PH2 corner collector (B2CC) is a non-spillway surface passage route. See FPP Chapter 2 for operating criteria.
	March 9–25	0600-1000, 1600-2000 daily	
	March 26 – August 31	24 hours/day, 7 days/week	
BON Sluiceway	Year-round	24 hours/day, 7 days/week	BON PH1 sluiceway is a non-spillway surface passage route. See FPP Chapter 2 for operating criteria.

A. Spill may be temporarily reduced below the FOP target spill level at any project if necessary to ensure navigation safety or transmission reliability, or to avoid exceeding State TDG standards.

7. SPRING FISH PASSAGE SPILL OPERATIONS

Spring spill operations occur April 3–June 20 at the four lower Snake River projects, and April 10–June 15 at the four lower Columbia River projects. The Corps initiates spill at 0001 hours, or shortly after midnight, at each of the projects on the start date. Target spill levels for spring 2024 at each project are defined in Table 4. If deleterious impacts of the proposed spill operations are observed in-season, existing adaptive management processes may be employed to address the cause of the impacts. Spill may be temporarily reduced at any project to ensure navigation safety or transmission reliability. In order to operate consistently with state water quality standards, spill may also be reduced if observed GBT levels exceed those identified in state water quality standards (See [WASH. ADMIN. CODE § 173-201A-200\(l\)\(f\)\(ii\)\(B\)\(III\)](#) and [Order Approving a Modification to the Oregon’s Water Quality Standard for Total Dissolved Gas in the Columbia River Mainstem](#), page 5).

Spill up to the 125% gas cap is spill to the maximum level that meets, but does not exceed, the TDG criteria allowed under state laws. This includes a criterion for not exceeding 126% TDG for the average of the two greatest hourly values within a day.

Table 4.— Summary of 2024 spring target spill levels at lower Snake River (April 3 – June 20) and lower Columbia River (April 10 – June 15) projects.

PROJECT	SPRING SPILL DATES	SPRING SPILL OPERATION
Lower Granite ^{A, C}	April 3 - June 20	24 hours/day: 125% Gas Cap
Little Goose ^{B, C}	April 3 – June 20	125% Gas Cap 24 hours/day (until adult criteria met), <i>then</i> 16 hours/day: 125% Gas Cap 8 hours/day: 30% Performance Standard
Lower Monumental ^A	April 3 - June 20	24 hours/day: 125% Gas Cap
Ice Harbor	April 3 – June 20	24 hours/day: 125% Gas Cap
McNary	April 10 – June 15	24 hours/day: 125% Gas Cap
John Day ^D	April 10 – June 15	40% Daytime 125% Gas Cap Nighttime
The Dalles ^E	April 10 – June 15	24 hours/day: 40% Performance Standard
Bonneville ^F	April 10 – June 15	24 hours/day: 125% Gas Cap

A. Lower Granite and Lower Monumental Adult Delay Criteria – See Section 7.1.

B. Little Goose Adult Criteria –Within 1 business day of when the earliest of the following conditions occurs: (1) a cumulative total of 25 adult spring Chinook salmon (not including jacks) pass Lower Monumental Dam; or (2) a cumulative total of 50 adult spring Chinook salmon (not including jacks) pass Ice Harbor Dam; or (3) April 24, 2024, the Corps will implement performance standard spill at Little Goose Dam for 8 consecutive AM hours (April 3–15 starting at 0500 hours; April 16–June 20 starting at 0400 hours) to target hours of peak adult passage. If lack of load conditions preclude the implementation of performance standard spill during the targeted periods, performance standard spill will begin as soon as practicable during AM hours and continue for up to 8 consecutive hours. If a second block is needed, it will start as soon as load conditions allow, continue for at least two consecutive hours, and conclude no later than 2000.

C. During periods of high river flow that exceeds powerhouse hydraulic capacity, implementing 8 consecutive hours of spill as described in Footnotes A and B may result in storing additional inflow in the forebay above MOP. If it is necessary to pond water to achieve the 8-hour block of spill during high inflow, water stored above MOP should be drafted out over the remaining hours by increasing spill to pass inflow from 1200-1600 hours, then increasing spill as necessary from 1600-0400 to draft the pool back to MOP. If it is forecasted that the drafting spill will result in exceeding 130% TDG in the tailrace, all 16 hours will be used to return the pool to MOP. In lack of load conditions performance standard spill blocks will be prioritized at Little Goose, Lower Monumental, and Lower Granite dams, in that order.

D. John Day Dam – Daytime hours are defined in FPP Chapter 4, Table JDA-5. Daytime hourly spill target of 40% river flows with ±5% flexibility in river flow for balancing reserves, consistent with current target spill level calculations.

E. The Dalles Dam –TDG in The Dalles tailrace may fluctuate up to 125% prior to reducing spill at upstream projects or reducing spill at The Dalles below 40%. Maintain 40% spill for 24 hours at The Dalles and reduce John Day spill below the 125% TDG spill cap as needed for TDG management. Spill above 40%, up to 125% TDG, may occur for TDG management or for carrying reserves.

F. Bonneville Dam – Spill for fish passage should not exceed 150 kcfs due to erosion concerns.

7.1. Adult Migration Delay Protocol for Spring Spill Operations at Lower Granite and Lower Monumental Dams

Lower Granite and/or Lower Monumental daytime spill levels will be decreased to 40% of project outflow for 8 hours per day during daytime hours (targeted start time between 0400-0800 if feasible) when adult delay or passage issues are observed at both/either of these projects. An adult delay or passage issue occurs when the following three criteria are met: (1) *fewer than 50%* of the daily cohort of PIT-tagged adult spring/summer Snake River Chinook detected at the downstream project (i.e., Ice Harbor or Little Goose dams) arrive at the upstream project (i.e., Lower Monumental or Lower Granite dams) within 3 days and this pattern persists for 3 consecutive days,²⁵ (2) a running 3-day minimum of 7 PIT-tagged adult spring/summer Snake River Chinook are detected at the downstream projects,²⁶ and (3) if the upstream dam's average outflow was below 160 kcfs each day of the delay. If all three criteria are met, the Corps will implement a 40% daytime spill operation (adult daytime spill operation) for 8 hours per day during daytime hours (targeted start time between 0400-0800 if feasible) on the next business day and continue for 3 consecutive days. Information on the three criteria would be available on day 4 and the adult daytime spill operation would begin the following business day (day 5). Consistent with past operations to reduce spill at Little Goose Dam, if lack of load conditions preclude the implementation of 40% spill to begin between 0400-0800, reduced spill will occur as soon as practicable during morning hours and continue for up to 8 consecutive hours. If 8 hours of consecutive spill at 40% was not feasible, a second block will start as soon as load conditions allow, continue for at least two consecutive hours, and will conclude no later than 2000 (see Table 4, footnote B).

Assuming *greater than 50%* of the daily cohort of PIT-tagged adults arrive at the upstream project by day 3 (information available on day 4), then standard operations (125% TDG spill 24/7) would be reinstated the following business day (day 5). If greater than 50% of the daily cohort does NOT arrive at the upstream project by day 3 and project average flow was below 160 kcfs, adult daytime spill operations would continue an additional day, and would be evaluated again the following day as previously described. This would continue until the adult delay or passage issue has been resolved and the standard operations can be reinstated as described in Table 4.

The TMT may consider in-season deviations from these criteria if unforeseen factors are reasonably expected to cause substantial delay (e.g., lack of load conditions, priority turbine unit outages, etc.) and the Fish Passage Operations and Maintenance (FPOM) Coordination Team may consider refinements to these triggers following each spring spill season.

²⁵ The return to 125% TDG spill 24/7 will be triggered if 50% or more of the running 3-day cohort for the most recent day (e.g., day 3 of adult daytime spill) is detected at the upstream dam. The agencies will use Columbia River DART's Reach Distribution and Delay for PIT Tag Adult Returns tool for this purpose.

²⁶ The agencies will use the current Columbia River DART's Reach Distribution and Delay for PIT Tag Adult Returns tool ("Running 3-day DART tool") to determine if criteria one and two have been met. See top panel, in-season graphics of Cumulative Arrival Percent by Days in Route to Lower Granite or Lower Monumental dams. https://www.cbr.washington.edu/dart/query/pitadult_reachdist

8. SUMMER FISH PASSAGE SPILL OPERATIONS

Summer spill operations occur June 21–August 31 at the four lower Snake River projects, and June 16–August 31 at the four lower Columbia River projects. The Corps initiates spill at 0001 hours, or shortly after midnight, at each of the projects on the start date. Target spill levels for summer 2024 at each project are defined in Table 5. At the Snake River Projects spill may range up to ± 1 kcfs during the summer spill operation from August 1 – August 31.

Table 5.— Summary of 2024 summer target spill levels at lower Snake River and lower Columbia River projects.

PROJECT	SUMMER SPILL ^A (June 21/16 – July 31) (24 hrs/day)	SUMMER SPILL ^A (August 1 – August 31) (24 hrs/day)
Lower Granite ^B	18 kcfs	SW flow (as river flow allows)
Little Goose ^{B, C}	30%	SW flow or 7 kcfs
Lower Monumental ^{B, D}	17 kcfs	SW flow or 8 kcfs
Ice Harbor ^{B, E}	30%	SW flow or 9 kcfs
McNary ^F	57%	SW flow or 20 kcfs
John Day	35% ^G	SW flow ^H or 20 kcfs
The Dalles	40% ^G	30% ^G
Bonneville	95 kcfs	50 kcfs

A. Spill may be temporarily reduced below the FOP target summer spill level at any project if necessary to ensure navigation safety or transmission reliability, or to avoid exceeding State TDG standards.

B. Late summer spill August 1-August 31 will be through the SW or a constant spill rate through conventional spillbays using the appropriate FPP spill pattern. The SW spill rate is a function of forebay elevation (as pool elevation increases, more water is spilled over the SW), as defined in the FPP. The SWs will be operated per FPP criteria and closed when low flow criteria are met. When the SW is closed, the spill target will transition to a constant spill rate through conventional spillbays and will not vary with a fluctuating forebay elevation.

C. Flow corresponds to the Little Goose SW high crest elevation as adjusted relative to the forebay operating range (see FPP Chapter 8, section 2.3.2.7).

D. Flow corresponds to a Lower Monumental forebay elevation of 538.5 feet, the mid-point of the forebay range from 537-540 feet.

E. Flow corresponds to an Ice Harbor forebay elevation of 438.5 feet, the mid-point of the forebay range from 437-440 feet.

F. From June 16-July 31, McNary will adjust spill once a day to 57% of the previous day's average project outflow. The intent is to reduce the frequency of spillgate changes while implementing a more uniform pattern to the extent it can be done safely (see FPP Chapter 5, section 2.2.1.1).

G. Hourly spill percentage target of river flow with $\pm 5\%$ flexibility of river flow for balancing reserves, consistent with current target spill level calculations.

H. John Day will also spill from bay 2 open 1 stop (approximately 1.6 kcfs) during daylight hours when spill is through the SWs only to maintain attraction flow to the north adult ladder, per FPP Chapter 4 (JDA), section 2.2.3.

9. PROJECT-SPECIFIC OPERATIONS

The following sections describe 2024 spill operations for each project. The Corps implements established spill patterns for all projects as described in the FPP. Additional information regarding spill precision outside these dates may be found in Section 3 above.

9.1. Lower Granite Dam

9.1.1. Fall/Winter Surface Spill (Table 3). The Lower Granite SW spill rate will increase with increasing forebay elevation, from approximately 5.6 kcfs at the bottom of the normal forebay operating range up to 11.4 kcfs at the top of the range (see FPP Chapter 9, section 2.3.2.6).

- March 1–20: SW spill 4 hours/day in the morning, 7 days/week.
- March 21 – April 2: SW spill 24 hours/day, 7 days/week.
- September 1 – November 15: SW spill 4 hours/day in the morning, 7 days/week.

9.1.2. Spring Spill (Table 4): 125% gas cap 24 hours/day April 3–June 20, unless adult passage delay is observed (see Section 7.1), then 125% gas cap (see Section 2.1), 16 hours/day, and 40% spill, 8 hours/day.

9.1.3. Summer Spill (Table 5):

- June 21–July 31: 18 kcfs, 24 hours/day.
- August 1-August 31: SW flow, 24 hours/day.

9.1.4. Operational Considerations: During low flow when spill is less than 15 kcfs and the SW is open, Lower Granite will transition to alternate spill patterns defined in FPP Table LWG-7-ALT if needed to maintain the tailwater elevation at no lower than 633 feet. The project will switch to these alternate patterns to avoid or minimize the need to raise the Little Goose forebay operating range to keep from dropping below the Lower Granite minimum tailwater elevation.

9.2. Little Goose Dam

9.2.1. Fall/Winter Surface Spill (Table 3). The Little Goose SW will be adjusted relative to forebay up to once per day to maintain a “high crest” elevation and a minimum of 7 kcfs spill (see FPP Chapter 8, section 2.3.2.7).

- March 1–20: SW high crest 4 hours/day in the morning, 7 days/week.
- March 21 – April 2: SW high crest 24 hours/day, 7 days/week.
- September 1 – November 15: SW high crest 4 hours/day in the morning, 7 days/week.

9.2.2. Spring Spill (Table 4): 125% gas cap (see section 2.1) 24 hours/day April 3 until adult criteria are met, then 16 hours/day, and 30% performance standard 8 hours/day through June 20 (Table 3, footnote B).

9.2.3. Summer Spill (Table 5):

- June 21–July 31: 30% (unless adjusted to a constant spill level during low flows, as described in Operational Considerations below), 24 hours/day.
- August 1–August 31: SW flow or approximately 7 kcfs, 24 hours/day.

9.2.4. Operational Considerations:

- When the spillway weir is closed and project outflow is less than or equal to 38 kcfs, actual hourly average spill levels at Little Goose may range up to $\pm 4\%$ according to the spill pattern Table LGS-11 in the FPP (Chapter 8).
- During low flow conditions at Little Goose, spill may exceed the target percentage if the spillway weir is in service and the project is restricted to a fixed minimum spill level (i.e., spill cannot be reduced below the spill rate through the spillway weir, which may result in spilling more than the target percentage at lower outflows).
- During the 30% spill operation when project outflows are ≤ 32 kcfs, the spill operation will transition from 30% to a constant spill level of approximately 7-11 kcfs to help stabilize project outflow, meet Lower Monumental target spill levels, and maintain MOP elevation at Little Goose. The constant spill level will be based on the previous day's average total project outflow, as follows: 11 kcfs when total outflow is 28.0 to 32.0 kcfs, 9 kcfs when total outflow is 24.0 to 27.9 kcfs, and 7 kcfs when total outflow is ≤ 23.9 kcfs. Actual spill may range up to ± 1 kcfs from the target spill level. Spill changes will be made by 0300 each day.

9.3. Lower Monumental Dam

9.3.1. Fall/Winter Surface Spill (Table 3). The Lower Monumental SW spill rate will increase with increasing forebay elevation, from approximately 6.7 kcfs at the bottom of the forebay operating range up to 9.5 kcfs at the top of the range (see FPP Chapter 7, section 2.3.2.6).

- March 1–20: SW spill 4 hours/day in the morning, 7 days/week.
- March 21 – April 2: SW spill 24 hours/day, 7 days/week.
- September 1 – November 15: SW spill 4 hours/day in the morning, 7 days/week.

9.3.2. Spring Spill (Table 4): 125% gas cap (section 2.1), 24 hours/day April 3–June 20, unless adult passage delay is observed (Section 7.1), then 125% gas cap (see section 2.1)

using the uniform spill pattern, 16 hours/day, and 40% using the uniform spill pattern, 8 hours/day.

9.3.3. Summer Spill (Table 5):

- June 21–July 31: 17 kcfs (bulk pattern), 24 hours/day.
- August 1–August 31: SW flow or approximately 8 kcfs, 24 hours/day.

9.3.4. Operational Considerations: Transit of the juvenile fish barge across the Lower Monumental tailrace, docking, and departure from the collection facility, may require a reduction in spill below the target spill level for safety concerns. The towboat captain may request spill be reduced or eliminated during transit. During juvenile fish barge loading operations, spill is typically reduced to 15 kcfs using the bulk pattern, but can be reduced further, if necessary, for safety reasons. Barge loading duration can be up to 3.5 hours. Reducing spill may cause the Lower Monumental pool to briefly operate outside of MOP elevations.²⁷

9.4. Ice Harbor Dam

9.4.1. Fall/Winter Surface Spill (Table 3). The Ice Harbor SW spill rate will increase with increasing forebay elevation, from approximately 7.1 kcfs at the bottom of the forebay operating range up to 10.4 kcfs at the top of the range (see FPP Chapter 6, section 2.3.2.6).

- March 1–20: SW spill 4 hours/day in the morning, 7 days/week.
- March 21 – April 2: SW spill 24 hours/day, 7 days/week.
- September 1 – November 15: SW spill 4 hours/day in the morning, 7 days/week.

9.4.2. Spring Spill (Table 4): 125% gas cap (see section 2.1), 24 hours/day, April 3–June 20.

9.4.3. Summer Spill (Table 5):

- June 21–July 31: 30%, 24 hours/day.
- August 1–August 31: SW flow or approximately 9 kcfs, 24 hours/day.

9.4.4. Operational Considerations:

- When the SW is open, the minimum project spill level is fixed at approximately 7.1–8.7 kcfs, depending on forebay elevation (i.e., spill cannot be reduced below the fixed volume through the SW). This operational limitation results in spilling more

²⁷ With spill levels in spring 2024 targeting the gas cap for at least 16 hours/day, reducing spill at Lower Monumental for long durations could pose problems for staying within MOP at Ice Harbor Dam, the next downstream project.

than 30% when total outflow drops below approximately 28 kcfs. Per FPP section 2.3.2.7, the SW is closed when day average outflow is below 30 kcfs and forecasted to stay below 30 kcfs for at least 3 days. However, outflow may drop below 28 kcfs on an hourly basis while the SW is still open, resulting in spill greater than 30% for those hours.

- Currently, all but one of the five available Ice Harbor turbines have runner blades that are locked at a set angle (non-adjustable) and a smaller operating range (also referred to as “fixed-blade” or “locked-blade” units). Only Unit 3 has adjustable blades. As a result, turbine outflow cannot achieve some flow ranges, referred to as deadbands. When targeting spill as a percent of outflow, these deadbands will result in a spill percentage that is above or below the target percentage at certain outflows. Unit 1 is currently out of service until 2026 to install a new adjustable-blade runner design.

9.5. McNary Dam

9.5.1. Fall/Winter Surface Spill (Table 3). The McNary SW spill rate will increase with increasing forebay elevation, from approximately 8 kcfs at the bottom of the normal forebay operating range up to 11 kcfs at the top of the range.

- March 1–20: Spillbay 20 SW 4 hours/day in the morning, 7 days/week.
- March 21 – April 9: Spillbay 20 SW 24 hours/day, 7 days/week.
- September 1 – November 15: Spillbay 20 SW 4 hours/day in the morning, 7 days/week.

9.5.2. Spring Spill (Table 4): 125% gas cap (see section 2.1), 24 hours/day, April 10–June 15.

9.5.3. Summer Spill (Table 5):

- June 16–July 31: 57% of the previous day’s average outflow, 24 hours/day. Spill changes will be made by 0300 each day.
- August 1-August 31: 20 kcfs, 24 hours/day.

9.5.4. Operational Considerations:

- Currently, McNary spillbays are restricted due to hoists and cranes that need replacement. As a result, McNary will implement modified spill patterns. For more information, see FPP Chapter 5 (MCN), section 2.2.
- Currently, McNary Dam turbine units 5 and 6 have runner blades that are locked at a set angle (non-adjustable). As a result, the units are restricted to a very narrow $\pm 1\%$ operating range of approximately 10-12 kcfs (see FPP Chapter 5 Table MCN-

6-A) and there may instances when the unit is unable to stay within this restricted range.

9.6. John Day Dam

9.6.1. Fall/Winter Surface Spill (Table 3).

- March 21 – April 9: Spillbay 19 SW spill 24 hours/day, 7 days/week.
- Opening the SWs at John Day Dam requires a crew and gantry crane and must be done during daylight hours as weather allows. On March 21, spill will occur at an equivalent rate (approximately 10 kcfs) with the non-SW pattern in FPP Table JDA-9 from 0001 hours until the SW is opened in the morning.

9.6.2. Spring Spill (Table 4): 40% daytime and 125% gas cap nighttime April 10–June 15 with priority to maintain 40% spill for 24 hours at The Dalles Dam as needed for TDG management. Daytime hours are defined in FPP Chapter 4, Table JDA-5. A crew will install the SW in spillbay 18 on the first day of spring spill as early as possible during daylight hours (see SW operating criteria in FPP Chapter 4, section 2.3.2.4).

- Daytime 40% spill with $\pm 5\%$ flexibility of river flows for balancing reserves, consistent with current target spill level calculations. Deviations outside of $\pm 5\%$ of river flow for reserves within the Bonneville balancing authority area will be reported in the Pre-Coordinated Operations Table in the monthly FOP implementation report (see section 10). Any other exceedances for reserves will be reported in the Variance Table in the monthly FOP implementation report.

9.6.3. Summer Spill (Table 5):

- June 16–July 31: 35%, 24 hours/day with $\pm 5\%$ flexibility for balancing reserves, consistent with current target spill level calculations. Deviations outside of $\pm 5\%$ of river flows for reserves within the Bonneville balancing authority area will be reported in the Pre-Coordinated Operations Table in the monthly FOP Implementation Report (see section 10). Any other exceedances for reserves will be reported in the Variance Table in the monthly FOP Implementation Report.
- August 1-August 31: 20 kcfs, 24 hours/day. Both SWs will be closed on the last normal workday of summer spill as late in the day as possible. Spill will be maintained at 20 kcfs through midnight on August 31 using the spill patterns with no SWs (see SW operating criteria in FPP Chapter 4, section 2.3.2.4).

9.6.4 Operational Considerations:

- Currently, turbine units 3, 8, 9, 10, 11, 13, and 14 at John Day have runner blades that are locked at a set angle (non-adjustable) and a smaller operating range (see FPP Chapter 4 Table JDA-7-A). As a result, the turbines have a restricted operating range of approximately 17-19 kcfs and may not be able to stay within the narrow 1% turbine band associated with it.

- See the WMP sections 6.11.1.4 and Tables 2 and 5 and Section 6.11.1.3 for discussion of springtime pool elevations to dissuade nesting of Caspian terns. This operation is also described in the FPP Appendix A. This operation will increase the flow rate over the SW and may change tailrace flow patterns.

9.7. The Dalles

9.7.1. Fall/Winter Surface Spill (Table 3): The ice & trash sluiceway (ITS) is a powerhouse (non-spillway) surface passage route and will operate March 1–December 15, 24 hours/day, pursuant to criteria in FPP Chapter 3.

9.7.2. Spring Spill (Table 4): 40%, 24 hours/day, April 10–June 15. Maintain 40% spill for 24 hours at The Dalles Dam and reduce John Day 125% TDG spill cap as needed for TDG management.

9.7.3. Summer Spill (Table 5):

- June 16-July 31: 40%, 24 hours/day with $\pm 5\%$ flexibility for balancing reserves, consistent with current target spill level calculations. Deviations outside of $\pm 5\%$ of river flow for reserves within the Bonneville balancing authority area will be reported in the Pre-Coordinated Operations Table in the monthly FOP Implementation Report (see section 10). Any other exceedances for reserves will be reported in the Variance Table in the monthly FOP Implementation Report.
- August 1-August 31: 30%, 24 hours/day with $\pm 5\%$ flexibility for balancing reserves, consistent with current target spill level calculations. Deviations outside of $\pm 5\%$ of river flow for reserves within the Bonneville balancing authority area will be reported in the Pre-Coordinated Operations Table in the monthly FOP Implementation Report (see section 10). Any other exceedances will be reported in the Variance Table in the monthly FOP Implementation Report.

9.7.4. Operational Considerations:

- Spill bays 9²⁸, 10, 11, 13, 16, 18, 19, and 23 are operationally restricted due to wire rope, structural and concrete erosion concerns.

9.8. Bonneville Dam

9.8.1. Fall/Winter Surface Spill (Table 3). The PH1 ice & trash sluiceway (ITS) and PH2 corner collector (B2CC) are powerhouse (non-spillway) surface passage routes and will operate pursuant to criteria in FPP Chapter 2:

- March 1–8: B2CC daily 0600-1000 hours.

²⁸ Spillbay 9 at The Dalles cannot be used due to failure of the trunnion pin in 2009.

- March 9–25: B2CC daily 0600-1000 and 1600-2000 hours.
- March 26–August 31: B2CC 24 hours/day, 7 days/week (beginning at 0600 on March 26).
- Year-round: ITS 24 hours/day, 7 days/week. From December 15–end of February, the ITS may be closed for up to 6 hours/day for maintenance.

9.8.2. Spring Spill (Table 4): 125% gas cap up to maximum of 150 kcfs for fish passage spill (see section 2.1), 24 hours/day, April 10–June 15.

9.8.3. Summer Spill (Table 5):

- June 16-July 31: 95 kcfs, 24 hours/day.
- August 1-August 31: 50 kcfs, 24 hours/day.

9.8.4. Operational Considerations:

- Maximum fish passage spill level is 150 kcfs. This constraint is based on physical model observations indicating an increased incidence of rock deposition into the spillway stilling basin at spill \geq 150 kcfs, which has caused erosion to the structure in the past.
- Minimum spill level is 50 kcfs; however, as observed in past years, to provide acceptable juvenile fish egress conditions in the tailrace under extreme low flow conditions, lower spill levels may be considered and coordinated through the TMT and/or FPOM.
- Actual hourly average spill levels at Bonneville Dam may range up to \pm 3 kcfs according to spill pattern tables in FPP Chapter 2.
- The Corps will be conducting Bonneville Dam Powerhouse II, Fish Guidance Efficiency Test during the spring and summer. This operation is included in FPP Appendix A. The Corps will continue coordination of this test via the regional forum(s) (SRWG and FPOM).

10. FOP IMPLEMENTATION REPORTING

The Corps posts monthly FOP Implementation Reports between April and August on the following website: http://pweb.crohms.org/tmt/documents/FOP_Implementation_Reports/. The updates include monthly project plots containing the following information:

- total flow: the total hourly river flow rate;
- generation flow: the hourly flow through the powerhouse turbine units;
- target spill: the spill target for that hour (Tables 3, 4 and 5);
- adjusted spill: the hourly spill level that can be achieved taking into consideration that spill may vary as a function of total river flow, forebay elevation, and generator capacity, and is

subject to routine operational adjustments that limit the ability to spill to the target spill (see section 4.1);

- actual spill: the hourly flow over the spillway; and,
- resultant 12-hour average TDG for the tailwater at each project.

The reports also provide information on non-routine or unplanned operational adjustments that arise during the spill program and address any spill adjustments due to emergency situations (such as unplanned maintenance or outages), and for contingency operations for transmission reliability. See section 4.1 for more information.

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

- Hourly flow, generation flow, and spill quantity data for the lower Snake and Columbia River dams are posted to the following website:
 - <http://pweb.crohms.org/report/projdata.htm> (web reports with the most recent 8 days of hourly project data and the current month of daily project data).
 - <http://pweb.crohms.org/tmt/wq/historical/> (links to historic hourly project data files in .csv format organized by month back to 2004 including temperature and TDG information).
- Water quality data are received via satellite from TDG Fixed Monitoring Sites (FMS) in the Columbia and Snake rivers every hour and placed on a Corps public website upon receipt. Hourly TDG and water temperature data are posted to the following websites:
 - <http://pweb.crohms.org/report/total.html> (web reports with hourly TDG, project outflow and spill for the previous 3 days).
 - http://pweb.crohms.org/ftppub/water_quality/tdg/ (links to historic hourly water quality data files for each FMS including barometric and total gas pressure, TDG and project outflow and spill in csv-format organized by month back to 2005).
 - Using the hourly TDG readings for each station in the lower Snake and Columbia rivers, the Corps calculates both the highest 12-hour average TDG levels (Oregon and Washington spring method) and the highest consecutive 12-hour average TDG levels (Washington summer method) on a daily basis. These averages are reported at: http://pweb.crohms.org/ftppub/water_quality/12hr/.
- Spill cap information is posted to the following site each day:
<http://pweb.crohms.org/tmt/documents/ops/spill/caps/>.

In addition to the monthly FOP Implementation Reports, the Corps provides status updates at the regularly scheduled TMT meetings about the 2024 fish passage spill operations, including reasonably detailed information that is relevant to the Corps' process for implementing fish passage spill.