

## SECTION 2

### BONNEVILLE DAM

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## Bonneville Dam

**1. Fish Passage Information.** The locations of fish passage facilities are shown on the following general site plans for Bonneville Lock and Dam (Figures BON-1 through BON-3). Dates for project operations for fish purposes and special operations are listed in Table BON-1.

### **1.1. Juvenile Fish Passage.**

**1.1.1. Facilities Description, First Powerhouse.** Juvenile fish passage facilities at the Bonneville first powerhouse consist of STSs, VBSs, 12" gatewell orifices, fish bypass channel, excess water elimination facility, fish sampler, and a 24" fish transport pipe to the tailrace. All 10 main turbine units have STSs. A small unit (unit 0) is located at the south end of the powerhouse and is not equipped with screens.

There are also small channels associated with the auxiliary water intakes for adult fishways at the south end of the powerhouse and at both ends of the spillway. These older juvenile fish passage channels discharge into the adult fishways at the ends of the spillway and into the ice and trash sluiceway at the south end of the powerhouse. These facilities are no longer operated on a regular basis.

**1.1.2. Facilities Description, Second Powerhouse.** Juvenile fish passage facilities at the Bonneville second powerhouse are comprised of turbine intake extensions (TIEs), streamlined trash racks, STSs, VBSs, two 13" orifices per gatewell in units 11-14 and fish unit 2, and one 13" orifice in all other gatewells flowing into a fish bypass channel, an excess water elimination facility, and a 48" fish transport pipe which connects the bypass channel to the tailrace. A 48" and 42" transport pipe at the high and low outfalls respectively, transport fish to the tailrace at the new outfall location. A juvenile fish sampling facility is included in the bypass. All eight main turbine units have STSs, TIEs, and streamlined trashracks. Two smaller turbines that supply adult fishway auxiliary water do not have STSs, TIEs, or streamlined trashracks however, have a fine trashrack with a 0.75 inch clear opening.

**1.1.3. Juvenile Migration Timing.** The juvenile fish migration season occurs from March 1 through November 30. Table BON-2 shows the primary passage periods for each species. Maintenance of juvenile fish facilities is scheduled for the period December 16 through February to reduce the impact on downstream migrants. These activities will be coordinated to minimize potential impacts on juvenile migrants that may be present at that time.

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Reserved for Figure BON-4

Reserved for Figure BON-5

Table BON-1. Dates of project operations for fish purposes at Bonneville Dam, 2000.

Reserved for page 2 of Table BON-1.

**Table BON-2. Juvenile fish migration timing at Bonneville Dam, 1993-1999.**

% Past Project <sup>a</sup>	Year/Date						
	1993	1994	1995	1996	1997	1998	1999
Yearling Chinook							
10%	4/22	4/19	4/18	4/19	4/20	4/23	4/21
90%	5/28	5/31	5/26	5/27	5/26	5/23	5/30
Subyearling Chinook <sup>b</sup>							
10%	N/A	6/9	6/5	6/9	6/7	6/3 <sup>d</sup>	6/1 <sup>d</sup>
90%	N/A	7/26	7/15	7/18	7/29	7/20 <sup>d</sup>	7/25 <sup>d</sup>
Steelhead							
10%	5/10 <sup>c</sup>	5/3 <sup>c</sup>	5/4 <sup>c</sup>	4/27 <sup>c</sup>	4/29 <sup>c</sup>	5/2 <sup>c</sup>	4/27 <sup>c</sup>
90%	5/26 <sup>c</sup>	6/4 <sup>c</sup>	5/29 <sup>c</sup>	5/29 <sup>c</sup>	5/28 <sup>c</sup>	6/1 <sup>c</sup>	6/5 <sup>c</sup>
Coho							
10%	5/5	5/9	4/28	4/23	4/29	5/3	4/28
90%	5/25	6/5	5/29	5/28	6/4	6/4	6/7
Sockeye							
10%	5/17	5/13	5/10	5/4	5/6	5/10	5/10
90%	5/27	6/2	5/27	6/2	6/22	5/29	6/1

<sup>a</sup> Measured at the first powerhouse bypass trap.

<sup>b</sup> Large spring releases of tule stock subyearling chinook in Bonneville pool overshadow the summer upriver stock migration. To avoid this, these dates are for the middle 80% of the subyearling chinook run which occurs after June 1.

<sup>c</sup> Dates are for hatchery steelhead. Wild steelhead averaged a few days earlier for the 10% and 90% passage.

<sup>d</sup> "Brights" only.

## 1.2. Adult Fish Passage.

**1.2.1. Facilities Description.** Adult fish passage facilities at Bonneville Dam consist of two main fishway segments. The first powerhouse collection system with A-branch ladder and the south spillway collection system with B-branch ladder join together at the Bradford Island ladder to form the Bradford Island fishway segment. The Cascades Island ladder at the north side of the spillway is connected to the Washington shore ladder by the upstream migrant transportation (UMT) channel. The second powerhouse collection system/ladder join together at the Washington shore to form the Washington shore fishway segment. Both the Bradford Island and the Washington shore fishways have counting stations. The second powerhouse ladder has an adult fish sampling facility. All four collection systems have auxiliary water supplies for fish attraction.

**1.2.2. Adult Migration Timing.** Upstream migrants are present at the project throughout the year and adult passage facilities are operated year round. Because passage through the winter months is relatively light, fish counting is by video taping (no visual counting), primarily to monitor winter steelhead passage. The adult fish counting schedule is shown in Table BON-3. Annual winter maintenance of adult fish facilities is scheduled from December 1 through February (in-water work period) to minimize the impact on upstream migrants and to minimize adult fall chinook and steelhead fallback.

**Table BON-3. Adult fish counting schedule.**

Period	Counting Method
January 1 - March 31	Video count 24 hours/day
April 1 - October 31	Visual count 16 hours/day (0400-2000 PST)
April 1 - October 31	Video Count 8 hours/day (2000-0400 PST)
November 1 December 31	Video count 24 hours/day

Adult migration count data for Bonneville Dam have been collected since 1938. Table BON-4 summarizes adult fish passage timing through 1998. The primary passage period and the earliest and latest peaks of migration recorded are listed for each species (from fish counts compiled by the Corps).

**Table BON-4. Adult migration timing from fish counts, 1938-1999.**

Species	Count Period	Earliest Peak	Latest Peak
Spring chinook	3/14 - 5/31	4/15	5/27
Summer Chinook	6/1 - 7/31	6/5	7/31
Fall Chinook	8/1 - 11/15	8/31	9/17
Steelhead	3/15 - 11/15	7/16	9/22
Coho	7/15 - 11/15	8/29	9/22
Sockeye	6/1 - 8/15	6/22	7/13

## **2. Project Operation.**

**2.1. General.** Yearling chinook and most other juvenile salmonids migrate downstream in the spring, whereas during the summer, after mid-June, sub-yearling chinook dominate. Studies specific to Bonneville Project indicate that fish survival rates for passage through various routes differ between spring and summer. For this reason, distribution of flow between powerhouses and spill volume will change as described in sections 2.1.1. and 2.2.

**2.1.1. Powerhouse Flow Distribution.** Bonneville turbine operating priority is established as outlined in Table BON-5. Follow the listed priority during the appropriate calendar periods. If a turbine is out of service, use the next turbine in the priority list. Improvements in 115 kilovolt line capacity are expected to be completed this year so that the second powerhouse can operate to meet local as well as system power needs independently of the first powerhouse. Until such time as these improvements are completed, the unit operating priorities shown for the June 21 through August 31 period will be used during the March 1 through November 30 fish passage season.

**Table BON-5. Turbine unit operating priorities, Bonneville first and second powerhouses.**

<b>PERIOD</b>	<b>PRIORITY</b>
0001 March 1 through 2400 June 20	18,11,17,12-16, 10,9,1,2,6,4,5,7,8,3
0001 June 21 through 2400 August 31	10,9,1,2,6,4,5,7,8,3, 18,11,17,12-16
0001 September 1 through 2400 November 30	18,11,17,12-16, 10,9,1,2,6,4,5,7,8,3
0001 December 1 through 2400 February 28	
Washington Shore Adult Fish Ladder Out of Service	10,9,1,2,6,4,5,7,8,3,18,11,17,12-16
First Powerhouse Adult Fish Ladder Out of Service	18,11,17,12-16,10,9,1,2,6,4,5,7,8,3
First Powerhouse and Washington Shore Adult Fish Ladders In Service	18,11,17,12-16,10,9,1,2,6,4,5,7,8,3

**2.1.2. Other Activities.** Research, non-routine maintenance, other fish-related activities, and construction activities will not be conducted within 100' of any fishway entrance or exit or within 50' of the rest of the fishway, unless concurred with by regional fish managers through ESA and other fish passage forums. Currently approved special operations are described in Appendix A. Alternate actions will be considered by district and project biologists in coordination with the fish managers on a case by case basis. Emergency situations should be dealt with immediately by the project in consultation with the project or district biologist. If unavailable, the biologists will be informed of steps taken to correct the situation immediately

following the incident. All activities within boat restricted zones (BRZ) will be coordinated in advance with the project.

**2.2. Spill Management.**

**2.2.1. General.** Regardless of time of day, only one spill schedule will be used at Bonneville Dam (Table BON-14, end of section 2). Nighttime spill is limited as necessary to control total dissolved gas (TDG) supersaturation. Adjustments of the nighttime spill level may be granted on a case-by-case basis by the Reservoir Control Center (RCC), dependent upon TDG monitoring at stations downstream of the dam, biological monitoring, and fish movement. The hours of nighttime spill are the daily complements of the periods of daytime spill (Table BON-6). The transition from daytime spill cap to nighttime spill cap and vice versa will normally take 15 to 20 minutes due to the time required to start, synchronize, and load multiple generators. Frequently, a total river discharge change will occur concurrently with these spill transitions. The transition to the daytime cap should begin early enough in the day to minimize chances of violating the defined daytime spill maximum. The transition to the nighttime spill period should not start until after the daytime cap period is over.

**2.2.2. Juvenile Fish.** Spill for juvenile fish passage will begin April 20 and end August 31 (1998 Supplemental Biological Opinion). The daytime spill amount is 75 kcfs in order to reduce adult fallback (see section 2.2.3). At night, the spill amount will be up to the 120% gas cap. The second powerhouse ice and trash chute will be operated for ice and trash removal and for emergency auxiliary adult transportation channel water supply only as outlined in section 3.3.2.1.c. (second paragraph).

**2.2.3. Adult Fish.** During the primary adult fish passage period, March 1 through November, daytime spill will be limited to 75 kcfs whenever possible. Normally, this restriction will be from one hour before sunrise to one half hour before sunset (see Table BON-6. However, during the sockeye passage season, which begins when at least 10 fish pass the project per day (in combined ladder counts), but no later than June 1 through August 15, the cap will apply until one hour after sunset.

**Table BON-6. Daytime spill schedule for Bonneville Project.**

Date	Daytime Spill
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	<b>Begin</b>	<b>End</b>
Mar 1 - 17	0530	1745
Mar 18 - Apr 1	0500	1800
Apr 2 - 21 <sup>1</sup>	0530	1930
Apr 22 - May 10	0500	1945
May 11 - 31	0430	2015
Jun 1 - Jul 22 <sup>2</sup>	0430	2200
Jul 23 - 31	0500	2200
Aug 1 - 15	0500	2130
Aug 16 - 31	0500	1930

<sup>1</sup> Times after April 2 are in Daylight Savings Time.

<sup>2</sup> Start date for sockeye passage varies.

### **2.3. Total Dissolved Gas (TDG) Management and Control.**

Implementation of spill requests will take into account TDG monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. The Corps will monitor TDG from a station in the Bonneville forebay and from several stations located below Bonneville Dam. The TDG data will be reported every four hours starting prior to an early Spring Creek National Fish Hatchery (NFH) fish release, but not later than March 10 for all stations at Bonneville. Spill volume and total project flow will be reported at the same time. The TDG data collection will continue year round at Bonneville forebay and Warrendale stations. The TDG monitoring plan is described in detail in Appendix D.

Excessive TDG levels, which may harm fish, will be controlled to the extent possible, subject to river flow conditions. Control measures will include system spill allocations through the spill priority list issued by RCC, nighttime or daytime spill limits, and shaping of spill discharge.

### **2.4. Juvenile Fish Passage Facilities.**

#### **2.4.1. Operating Criteria, First Powerhouse.**

##### **2.4.1.1. Prior to the Juvenile Fish Passage Season (December 1 through end of February).**

a. Remove debris from forebay, trash racks, and gatewell slots such that these areas are free of debris.

b. Inspect VBSSs for damage, holes, debris accumulations, and protrusions (video inspection acceptable). Clean and repair, as necessary, such that all VBSSs in operable units are

functional.

**c.** Inspect each STS and operate on a trial run (dogged off at deck level). Install STSs in each intake of operational turbine units by the end of February. However, see section 2.4.1.2. Juvenile Fish Passage Season about accommodations for an early fish release from Spring Creek NFH.

**d.** Inspect and, where necessary, clean and/or repair all gatewell orifices, orifice lighting systems, and flushing systems such that the orifices and associated systems are fully functional.

**e.** Inspect and, where necessary, clean and/or repair dewatering screens and associated equipment.

**f.** Inspect and correct any deficiencies of DSM channel and outfall conduit walls and floor.

**g. Avian Predation Lines.** Reinstall or repair avian predator control lines in present locations as soon as possible following damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary in areas where avian lines are not practical. Avian abatement measures shall be in place by March 1 unless this work is delayed because of inclement weather. If this occurs, the work will be completed as soon as the weather permits after that date.

**h. Inspections.** The results of all inspections and the readiness of the facilities for operation will be reported to the Fish Passage Operations and Maintenance (FPOM) Coordination Team at the meeting immediately prior to the juvenile fish passage season.

**2.4.1.2. Juvenile Fish Passage Season (March 1 through end of November).** Juvenile fish protection devices (STSs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before March 1. The release is typically scheduled for mid-March. Screens will remain in operation through December 15 to protect adult fallbacks.

**a.** Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from forebay and trashracks as required to maintain less than 1.5' of total drawdown in gatewells, or as indicated by fish condition (e.g., higher than expected descaling), or as determined by the project biologist and smolt monitoring personnel who sample the fish. The STSs in

units being raked will be run in continuous mode during raking operations. Gatewell orifices of the unit being raked must be closed during the procedure.

**b.** Operate STSs at an angle of 55 degrees from vertical.

**c.** Inspect each STS once per month (or 720 hours run time) and each VBS a minimum of once every two months (or 1440 hours run time) (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. No STS inspections will be scheduled when they will cause excessive TDG due to increased forced spill. Summaries of STS and VBS inspections will be included in weekly operation monitoring reports. VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 1, mid-July, and September 1. Inspections will be concentrated on the priority units and others with longer operating times. More frequent inspections may be required by the project biologist or under the following conditions: deterioration of fish conditions, increased debris load in bypass system, and other indications of STS or VBS malfunctions or failure. Prior to pulling VBSs for inspections, shut off units and dip gatewells. It is not necessary to dip gatewells of units which have been off for 48 hours or longer.

If STS or VBS damage or plugging is detected, follow procedures in Section 3. Fish Facilities Maintenance. Records of inspections or summary of such records will be made available to the Fish Passage Center (FPC) by January 31.

**d.** Operate all gatewell orifice systems. Inspect each orifice twice daily to assure that the orifice valves and lights are operating correctly. Orifices are set to automatically flush every 8 hours at 0200, 1000, and 1800 hours. More frequent back-flushing is recommended during the high debris period of April through June. Replace all burned out orifice lights within 24 hours.

**e.** DSM downwell area operation (during smolt sampling):

**1.** Maintain between 0.3' and 1' of depth over the end of the DSM inclined dewatering screen.

**2.** Maintain the differential between forebay and DSM channel water surface between 5' and 6'.

**3.** Maintain the drop from dewatering screen to water surface in the downwell between 4.5' and 6'.

4. Operate the dewatering screen trash sweep one revolution at 60-minute intervals. This interval between operations may be increased to one revolution every 20 minutes when monitoring personnel are not present depending on the amount of debris passing.

5. Electrical modifications were made in 1995 to allow central, automatic lighting control in the first powerhouse DSM. The DSM is now darkened on a schedule as determined through coordination with the FPOM in 1994. Investigation has shown that darkening the channel results in faster fish evacuation.

f. DSM downwell area operation (non-sampling standards).

1. Maintain a depth between 0.9' and 1.3' over the end of the DSM inclined dewatering screen.

2. Maintain the differential between forebay and DSM channel water surface between 5' and 6'.

3. Maintain the drop from dewatering screen to water surface in the downwell between 3' and 4.5'.

g. Observe each STS watt and/or amp gauge reading at least once each day and record readings once per day. If an STS failure occurs, then follow procedures in Section 3. Fish Facilities Maintenance.

h. Inspect all STS gatewells daily. The project will clean gatewells before the water surface becomes one-half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces half clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last on/first off basis. The first powerhouse gatewell orifices will be closed during cleaning operations. After cleaning a gatewell, back-flush the orifice in that gatewell then check gatewell drawdown.

i. A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. But, when unusual accumulations of oil (e.g., oil slick) occur in gate slots, they will be removed within 24 hours. When this is not possible, the JBS orifice will be closed and the turbine unit will be shut down until cleaning is accomplished. Appropriate procedures to remove fish during this situation will be determined in coordination with FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

**j.** Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

**k.** Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators.

**l.** Turbine units without a full complement of STSs will not operate except to be in compliance with other coordinated fish measures.

**m.** Open ice and trash sluiceway chain gate 7A to elevation 72' msl, and set gate 10C to full open. However, if the forebay is expected to stay below 72.5' for more than 48 hours (as during a specially-coordinated low forebay period), then gate 7A should be set at 70' above msl with gate 10C still full open. (Calculated from hydraulic equations to achieve approximately 475 cfs (3.7' of head) (Evaluation of Ice and Trash Sluiceway at Bonneville Dam as a Bypass System for Juvenile Salmonids, 1981). The ice and trash sluiceway may be operated without restriction October 1 through November if it is determined, through FPOM coordination, that migrating juvenile salmonid numbers are low enough that operations will not adversely affect fish migration or fish condition. This authorization may be terminated at any time if problems arise that negatively impact fish migration or condition.

**n.** Inspect juvenile fish passage facilities twice per day. Project fish biologist and fish biological staff will conduct at least three inspections per week.

**2.4.1.3. Winter Maintenance Season (December 16 through February).** The end of the season may be shortened for an early fish release from Spring Creek NFH. This will not be the case in 2000 since the Spring Creek NFH release is scheduled for March 9.

**a.** Remove all STSs.

**b.** When STSs are removed at the end of the fish passage season, they are normally stored in a position extending up through the forebay deck. An alternate storage position is below the deck, but this places the screens close in front of the gatewell orifice. When it is necessary to make room on the forebay deck for priority activities at this time of year by storing the screens beneath the deck, the blocked orifices should be closed. The DSM channel should be drained if proper operating criteria cannot be maintained as the result of a large number of

closed orifice valves.

#### **2.4.2. Operating Criteria, Second Powerhouse.**

##### **2.4.2.1. Prior to the Juvenile Fish Passage Season (December 1 through February).**

**a.** Remove debris from forebay, trash racks, and gatewell slots such that these areas are free of debris.

**b.** Inspect VBSs for damage, holes, debris accumulations, and protrusions (video inspection acceptable). Clean and repair, as necessary, such that all VBSs in operable units are functional.

**c.** Inspect each STS and operate on trial run (dogged off at deck level). Install STS in each intake of operational units by the end of February. However, see section 2.4.2.2. about accommodations when there is an early fish release from Spring Creek NFH.

**d.** Inspect and, where necessary, clean and/or repair all gatewell orifices, orifice lighting systems, and flushing systems such that the orifices and associated systems are fully functional.

**e.** Inspect and, where necessary, clean and/or repair dewatering screens and associated equipment.

**f.** Inspect and correct any deficiencies of DSM channel and conduit outfall walls and floor.

**g. Flume Pipe (from exit of DSM to outfall).** Visually inspect outfall flume pipe and associated switch gates once per year from the transition section leaving the powerhouse to the outfall return to the river for obstructions, protrusions, or structural deficiencies that may affect fish passage.

**h. Juvenile Monitoring Facility (all equipment).** Preseason inspections will focus on post-construction assessment of facility performance relative to contract requirements and potential for successful operation for fish passage. Additional operational criteria may be developed throughout the early part of the fish migration season.

**i. Avian Predation Lines.** Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain

new avian predator control lines in locations determined to be significantly impacted by avian predators. Implement other avian abatement measures as necessary in areas where avian lines are not practical. Avian abatement measures shall be in place by March 1 unless this work is delayed because of inclement weather. If this occurs, the work will be completed as soon as possible after that date.

**j. Inspections.** The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the juvenile fish passage season.

**2.4.2.2. Juvenile Fish Passage Season (March 1 through November).** Juvenile fish protection devices (STSS, TIEs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before March 1. Screens will remain in operation through December 15 to protect adult fallbacks.

**a.** Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from the forebay and trash racks as required to maintain less than 1.5' of drawdown in gatewells, or as indicated by fish condition (e.g., higher than expected descaling), or as determined by the project biologist. The STSS in units being raked will be run continuously during raking operations. Gatewell orifices of the unit being raked must be closed during the procedure.

**b.** Measure fish unit gatewell drawdown at least once per week. When the head across trash racks exceeds 1.5', the trash racks will be cleaned that day. This may be done by raking late in the work day or by turning the unit off at night and letting the debris float off the racks. However, if the head exceeds 3' or if the adult fishway head is reduced, the unit's racks will be raked immediately, even if it is early in the day. When debris accumulation is persistent, unit 18 may be operated while the fish unit is off at night to help draw loosened debris away. An FPOM task group will develop operational guidelines on an as-needed basis.

**c.** Operate STSS at angle of 60° from vertical.

**d.** Inspect each STS once per month (or 720 hours run time) and each VBS a minimum of once every two months (or 1440 hours run time) (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. No STS inspections will be scheduled when they will cause excessive TDG due to increased forced spill. Summaries of STS and VBS inspections will be included in weekly operation monitoring

reports. VBS inspections will occur immediately prior to peaks in juvenile fish migrations, which begin about May 1, mid-July, and September 1. Inspections will be concentrated on the priority units and others with the longer operating time. More frequent inspections may be required by the project biologist or under the following conditions: deterioration of fish conditions, increased debris load in bypass system, and other indications of STS or VBS malfunctions or failure. Prior to pulling VBSs for inspections, shut off units and dip gatewells. It is not necessary to dip gatewells of units which have been off for 48 hours or longer.

If STS or VBS damage or plugging is detected, follow procedures in section 3. Fish Facilities Maintenance. Records of inspections or a summary of such records will be made available to the FPC by January 31, upon request.

**e.** Operate all gatewell orifice systems. Inspect each orifice twice daily to assure that the orifice valves and lights are operating correctly. Orifices are set to automatically flush 3 times per day, one orifice every 10 minutes. Orifices with less than a clear flow jet will be flushed. Replace all burned out orifice lights within 24 hours. Electrical modifications were made in 1996 which allow central, automatic lighting control in the second powerhouse DSM. The DSM is now darkened on a schedule as determined through coordination with the FPOM in 1994. The DSM lights should be left off, per this guidance, except when people are in the gallery. Investigation has shown that darkening the channel results in faster fish evacuation.

**f.** Observe each STS watt and/or amp gauge at least once each day and record reading once per day. If an STS failure occurs, then follow procedures in Section 3. Fish Facilities Maintenance.

**g.** Inspect all STS gatewells daily. The project will clean gatewells before the water surface becomes one-half covered with debris. If, due to the volume of debris, it is not possible to keep the gatewell surfaces half clear, they will be cleaned at least once daily. Turbines with a gatewell fully covered with debris will not be operated except to be in compliance with other coordinated fish measures, and then only on a last on/first off basis. The second powerhouse gatewell orifices will be closed during the cleaning operations. After cleaning a gatewell, inspect and, if necessary, clean the orifice in that gatewell and then check gatewell drawdown.

**h.** A slight oily sheen is commonly found in many gatewells. This may come from sources such as lubricated lifting beams, etc. But, when unusual accumulations of oil (e.g., oil slick) occur in

gate slots, they will be removed within 24 hours. When this is not possible, the JBS orifice will be closed and the turbine unit will be shut down until cleaning is accomplished. Appropriate procedures to remove fish during this situation will be determined in coordination with FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

**i.** Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

**j.** Reinstall or repair avian predator control lines in present locations as soon as possible following significant damage or removal. Install and maintain new avian predator control lines in locations determined to be significantly impacted by avian predators.

**k.** Turbine units without a full compliment of STSSs will not operate except to be in compliance with other coordinated fish measures.

**l.** Inspect facilities twice per day. Project fish biologist and fish biological staff will conduct at least three inspections per week.

**m.** All TIEs will be removed following the spring juvenile yearling chinook outmigration period, usually in early July. The TIEs will be re-installed just prior to the start of the juvenile fish passage season, including, when practicable, prior to early fish releases from Spring Creek NFH.

#### **2.4.2.3. DSM2 Channel Operation.**

**a. Background.** The DSM channel is controlled by a Program Logic Controller (PLC) which receives analog signals representing the add-in water supply position, orifice positions, channel elevation, and dewatering screen cleaner operation. The new DSM channel consists of an add-in water supply system at the south end of the channel, 28 non-regulating (existing) orifices, 14 regulating (new) orifices, 19 dewatering weirs, 3 dewatering screen cleaners, and one airburst system. The add-in water supply system is designed to operated continuously to increase velocities at the south end of the channel. However, due to juvenile impingement on the perf plate during the 1999 season, operation was terminated. Consequently, the supply system will not be operated in 2000 unless modifications are made to eliminate juvenile impingement on the perf plate. Operation of the orifices is determined by the PLC measuring head differential between the channel and second powerhouse forebay. The 28 non-regulating orifices were part of the original system and are

designed to remain open with the exception of F2A-N and F2B-N orifices. These orifices are designated as the "north" orifices in the new system. The 14 regulating orifices are the new orifices installed during system modifications. These orifices are designated as the "south" orifices. There is one new regulating orifice in each gatewell slot in units 11-14 including two at fish unit 2. These orifices are designed to operate according to channel and forebay differential. They are operated to regulate channel elevation by opening beginning at the south end of the channel northward with the exception of the fish units. See Table BON-7 for regulating orifice criteria. Fish unit orifices F2B-S and F2A-S are designed to remain open in automatic control. As forebay decreases or head differential between the channel and forebay elevation decreases, the more regulating orifices there will be open. The dewatering weirs are manually set to maintain approximately 31 cfs entering the transportation flume. The three screen cleaners are designed to operate in automatic control, cycling every 3 hours or as determined by debris presence. The airburst system on the floor and wall screens upstream of the transportation flume entrance are designed to operate every 15 minutes.

**Table BON-7. DSM2 regulating orifice control (FB is forebay and "X" is open).**

Orifice	FB ≤71.5	FB ≤72.5	FB ≤73.5	FB ≤74.5	FB ≤75.5	FB ≤76.5
11A-S	X	X	X	X	X	
11B-S	X	X	X	X		
11C-S	X	X	X	x		
12A-S	X	X	X			
12B-S	X	X	X			
12C-S	X	X				
13A-S	X	X				
13B-S	X	X				
13C-S	X					
14A-S	X					
14B-S	X					
14C-S	X					

**b. Operation.** Maintain the channel elevation between 64.2' and 64.4' as indicated by the staff gauge in front of the ERG. The system is designed to maintain the channel elevation at 64.3' in automatic control. If the channel elevation increases or decreases, the PLC system will close or open orifices, respectively.

#### **2.4.2.4. Fish Transport Pipe and Flume.**

**a. Background.** A 48" fish transport pipe connects the DSM channel to the tailrace outfalls. The transport pipe leaves the DSM underground before opening-up to an open flume just upstream of the Juvenile Monitoring Facility (JMF). At this location, there is a switchgate (referred to as the upper switchgate) to divert the flume to sampling or bypass mode. Below the JMF, there is another switchgate (referred to as the lower switchgate) to divert fish to the high or low tailrace outfall. The high and low outfalls consist of 48" and 42" fish transport pipes, respectively.

#### **b. Operation.**

1. JMF personnel will operate the upper switchgate as necessary for sampling requirements.

2. JMF personnel or project biologists will operate the lower switchgate as necessary depending on tailwater elevation.

3. On seasonal ascending tailwater elevations, the transition from low to high outfall should be between tailwater elevations at the upper end of 17' to 13.5' range.

4. On seasonal descending tailwater elevations, the transition from high to low outfall should be between tailwater elevations at the lower end of 17' to 13.5' range.

5. Operate the outfall avian cannons from March 1 through July 31 or as coordinated through FPOM. Only operate the respective avian cannons depending on the release point (high or low outfall). The cannons will be operated from sunrise to sunset unless otherwise coordinated through FPOM.

#### **2.4.2.5. Juvenile Monitoring Facility.**

**a. Background.** The JMF is comprised of a transport flume, Primary Dewatering Structure (PDS), adult transport flume, juvenile hopper, Secondary Dewatering Structure (SDS), 3-way diverter gate, 2-way diverter gate, sampling facility, and juvenile release transport flume.

#### **b. Operation.**

1. JMF personnel will operate the sampling facility as

necessary to meet their sampling requirements. Operational criteria will be further refined during the 2000 fish migration season. The FPOM coordination team will be kept informed of progress and changes throughout the season.

2. The JMF will be monitored 24 hours per day, 7 days per week by PSMFC personnel to insure its proper functioning and provide quick response to an emergency while the JMF is in operation.

3. A person on duty will perform a walk-through inspection of the entire facility every two hours to ensure safe fish passage conditions.

4. Particular attention will be paid to the following: dewatering facilities including the PDS, SDS, PDS screen cleaner system, adult transport flume, juvenile hopper, all valves and auxiliary water systems, flushing water systems and their perforated plates, all gates including switch and diverter gates, PIT tag detectors, and all monitoring building systems including holding tanks, valves, and conduits to prevent injury and/or mortality to passing fish.

5. Ensure that outfall avian cannons are operating.

#### **2.4.2.6. System Failures.**

a. Any system failure will be reported to a project biologist as soon as possible. If a project biologist is unavailable, the control room will be contacted. The following actions should be taken in specific situations:

1. If a high water situation occurs in the PDS area, contact the control room immediately. If water level is uncontrollable, immediately switch the upper switchgate to bypass mode until the problem is corrected.

2. If a monitoring facility failure occurs, immediately switch the upper switchgate to bypass mode until repairs are made.

3. If a lower switchgate failure occurs that results in releasing to the wrong high or low outfall and repairs can not be made within 24 hours, the special operation will be coordinated through FPOM.

**2.4.2.7. Winter Maintenance Season (December 16 through February).** The end of the season may be shortened for an early fish release from Spring Creek NFH. To reduce adult fallback mortality, the juvenile bypass system, or DSM channel will

operate from November 30 through December 15. STSs in priority units will be left in place during this period. Screens from non-priority units may be removed between December 1 and 15, but only if scheduled for maintenance. In all units, screens that are not being serviced shall be left in place during this period. Unscreened units will be operated on a last-on, first-off basis. Beginning December 16, all remaining STSs may be removed. DSM may be dewatered (see section 5. Dewatering Plans) only when required for maintenance. The maintenance period will be minimized to the extent practicable. Facilities, when operating, are to be inspected at least once per day to assure criteria are being met. These inspections are to be performed at least three times per week by the project fish biologist and fish biological staff.

#### **2.4.3. Spillway Operating Criteria.**

##### **2.4.3.1. Prior to Juvenile Fish Passage Season (December 1 through February).**

a. Inspect and, where necessary, repair spill gates and control systems. The spillway, except for coordinated exceptions, must be able to achieve spill patterns on the first day of the juvenile fish passage season.

b. The results of all inspections and the readiness of the facilities for operation will be reported to the FPOM at the meeting immediately prior to the juvenile fish passage season.

**2.4.3.2. Juvenile Fish Passage Season (March 1 through November).** Bonneville Dam uses a single spill schedule for both day and night. Spill will be provided according to the guidance in section 2.2.

**2.4.3.3. Winter Maintenance Season (December 16 through February).** Refer to Appendix E for spill guidance during non-passage periods at Bonneville Project.

#### **2.5. Adult Fish Passage Facilities.**

##### **2.5.1. Operating Criteria.**

###### **2.5.1.1. Prior to Primary Adult Passage Period (December 1 through end of February).**

a. Inspect and calibrate all staff gauges and water level

indicators. Repair and/or clean where necessary.

**b.** Unless specially coordinated, dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or slow their progress up the ladder. Repair deficiencies.

**c.** Inspect for and, when necessary, clear debris in the ladder exits.

**d.** Reinstall picket leads at counting stations prior to watering up the ladders during maintenance.

**e.** The results of all inspections and the readiness of the facilities for operation will be reported at the FPOM meeting immediately prior to the passage season.

**2.5.1.2. Primary Adult Fish Passage Period (March 1 through end of November).**

**a. All Adult Facilities.**

**1.** Maintain the water depth over fish ladder weirs at 1' +/- 0.1' during the non-shad passage season (August 16 through May 14) and 1.3' +/- 0.1' during the shad passage season (May 15 through August 15). These water depths will be measured at the A and B-branch staff gages in the Bradford Island fishway, at weirs 37 and 38 in the Washington shore fishway, and in the Cascades Island just downstream of the entrance to the UMT. For FV3-9 calibration purposes to achieve the target depth in the A and B branches, the depth in the main ladder below the count station is 1.1' during shad passage and 0.9' during the non-shad season.

**2.** Water temperature will be measured in an adult fishway at each powerhouse. When water temperature reaches 70° F, all fish handling activities will be coordinated through FPOM prior to any action to verify protocols that will be followed. Fish handling activities in the Adult Fish Collection and Monitoring Facility (AFC&MF) will implement protocols in Appendix H.

**3.** Head on all entrances should be: 1' to 2' (1.5' preferred). Head at the NUE is calculated differently because the collection channel staff gauge is in the junction pool. A head of approximately 1' to 2' at the NUE entrance is indicated by a 1.2' to 2.2' (1.7' preferred) entrance head calculated using the fishway and tailwater staff gauges closest to NUE. Refer to section 3.3., Adult Fish Passage Facilities, when unable to achieve head criterion.

4. A water velocity of 1.5 to 4 fps (2 fps preferred) shall be maintained for the full length of the powerhouse collection channel, and the lower ends of the fish ladders which are below the tailwater. Water velocities will be measured directly, and monitored during fishway inspections to verify channels are operating between 1.5 and 4 fps. Water velocities in the UMT shall be maintained within criteria, but the channel will not contain a permanent velocity meter.

5. A maximum of 0.5' head will be allowed on the first powerhouse attraction water intakes and trash racks at all the ladder exits, with 4" maximum head on all picket leads. Debris shall be removed when significant amounts accumulate.

6. Staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period. These include the PH1 south collection channel, PH1 north collection channel, PH1 north tailwater, PH1 south forebay, BI A and B branch ladders, BI first weir, B branch entrance, CI entrance, CI ladder below the UMT entrance, NUE/NDE/SUE/SDE collection channel, NUE/SUE tailwater, and PH2 north forebay. Stillwells used in lieu of staff gauges will be checked for calibration once per week and summaries of these stillwell calibrations will be included in weekly operation monitoring reports.

7. The current fish counting program is conducted 24 hours per day, year around. Count station crowders shall remain in the operating position while visual counting and/or video taping is being conducted. The crowder shall be closed to allow the count slot width to be no less than 18". This will usually occur during high turbidity conditions to allow count accuracy criteria to be achieved. If passage is impaired by this condition, the count slot may be widened until proper passage conditions are achieved, even though count accuracy may be compromised to some degree. Project biologists, FFU, and the WDFW fish count supervisor shall coordinate to achieve optimum count slot passage and/or count accuracy conditions. If counting is temporarily discontinued due to unscheduled events, the crowder shall be fully opened. The crowder may remain in operating position during the counters' hourly ten-minute break period. Leave the fish passage slot lighted overnight.

8. Inspect facilities twice per day. Project fish biologist and fish biological staff will conduct at least three inspections per week.

9. Upstream light banks in both count stations shall remain off to facilitate fish passage through the count slot and help reduce the number of fish impacting the count window framework, unless other passage problems result, or count accuracy is compromised as determined by the fish count supervisor.

10. Inspect and ensure that optimum passage conditions are maintained at fishway entrances, exits, and in the count slots.

**b. Spillway Ladders.**

1. Spillway gates 1 and 18 shall be open 4" for adult attraction. This operation provides adult fish attraction flow adjacent to ladder entrances.

2. Side entrances SW-SG-5 and SO-SG-7 and downstream entrances SW-SG-1 and SO-SG-2 shall operate as continuously open free-flowing vertical slots. Downstream entrances SW-SG-3 and SO-SG-4 (adjacent to shore) consist of pairs of sluice gates. When the tailwater is below 9', sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be open. When the tailwater is between 9' and 17', sluice gates SO-SG-4S and SW-SG-3N shall close. When the tailwater exceeds 17', sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be closed.

**c. First Powerhouse.**

1. **General.** The Program Logic Controller (PLC) receives analog signals representing the 4 weir gate positions, the 5 orifice gate positions, the north, central, and south tailwater and collection channel water elevations, and the water pressure at the south end of the auxiliary water conduit. It also receives inputs from the bulkhead upper/lower limit switches. From this information, the PLC control program determines when to activate outputs which serve to raise or lower the weir gates, bulkheads, orifice gates, sluice gates, A branch diffusion gates, and fish valves FV1-1 and FV3-7.

2. **Weir Gates.** The first powerhouse weir gates will be operated as shown in Table BON-8.

3. **Gate Pairing.** The four weir gates will be operated in two pairs. Only one gate pair will be allowed to operate at any given time. Gates 1 and 65 will operate together as the active pair (enabled) for tailwater elevations greater than 23' msl., while gates 2 and 64 will operate together as the active

pair (enabled) for tailwater elevations less than 26' msl. For tailwater elevations between 23' and 26', the designated active pair will depend on whether the tailwater elevation has been rising or falling with a "dead band" of 1.5'.

**Table BON-8. Bonneville Dam first powerhouse weir gate requirements.**

Weir Gate	Submergence Requirement	Differential Requirement	Sill Elevation
1	>8'	1'-2'	8.5'
2	>8'*	1'-2'	2'
64	8'-8.4'	1'-2'	2'
65	8'-8.4'	1'-2'	8.5'

\* When tailwater is <13.5', the 8' submergence requirement can not be satisfied. From tailwater of 13.5' to 10.0' (when gate is on sill), the pressure differential between the auxiliary water supply conduit and the collection channel exceeds the safety limit of 10 psi.

**4. Gate Pair Enabling/Disabling.** If the tailwater elevation is 26' or greater, gates 2 and 64 will be closed off (raised to their maximum position and their bulkheads lowered) and their control disabled. Gates 1 and 65 will be enabled and will therefore operate as described above. Gates 1 and 65 will then continue to be enabled (and gates 2 and 64 closed off and their control disabled) until the tailwater elevation drops below 23'. Once this occurs, the bulkheads for gates 2 and 64 will be raised, the control for gates 2 and 64 will be enabled and these gates will be moved to their appropriate post-transition positions, and gates 1 and 65 will be raised to their maximum closed positions. The control for gates 1 and 65 will then be disabled. Gates 2 and 64 will then be the active pair.

If the tailwater elevation is less than 23', gates 1 and 65 will be closed off (raised to their maximum positions) and their control disabled. Gates 2 and 64 will be enabled and will then operate as described above. Gates 2 and 64 will then continue to be enabled (and gates 1 and 65 closed off and their control disabled) until the tailwater elevation rises to 26'. Once this occurs, the control for gates 1 and 65 will be enabled and these gates will be moved to their appropriate post-transition positions, gates 2 and 64 will be raised to their maximum positions, and the bulkheads for gates 2 and 64 will be lowered. The control for gates 2 and 64 will then be disabled. Gates 1 and 65 will then be the active pair.

**5. Transition Positioning.** During a transition, the former active pair is closed and the new active pair is positioned according to tailwater. If gates 1 and 65 are the active pair and the tailwater falls below 23', there is a transition in which gates 2 and 64 will be enabled and moved to their appropriate post-transition positions. Gates 1 and 65 will then be raised to their maximum closed position (26'). If gates 2 and 64 are the active pair and the tailwater rises to more than 26', there is a transition in which gates 1 and 65 then become the active pair. Gates 1 and 65 will be enabled and moved to their appropriate post-transition positions. Gates 2 and 64 will be raised to their maximum closed position (gate 2: 11', gate 64: 18'). In either case, there is a 1.5' "dead band" as described above.

**6. Control of Orifice Gates 9, 21, 34, 58 and 62.** Orifice gates open from tailwater elevation 16.2' to 36' on a rising tailwater and elevation 36' to 15.8' on a falling tailwater.

**7. Control of Sluice Gates 9, 21, 34, 58 and 62.** Sluice gates open from tailwater elevation 15.8' and less on a falling tailwater and close from tailwater elevation 16.2' and more on a rising tailwater.

**8. Control of Fish Valve FV1-1.**

**(a) Emergency Closure.** If the collection channel/tailwater differential is greater than 2.5' or if the pressure differential between the auxiliary water supply conduit and the collection channel exceeds 10 psi.

**(b) Differential.** Low: if the collection channel/tailwater differential is less than 1'. High: if the collection channel/tailwater differential is more than 2.0'.

**9. Control of Fish Valve FV3-7.** Maintain the opening concurrent with the charts for valve opening, as set by the forebay and tailwater elevations.

**10. Control of A-Branch Diffusion Gates FG3-3, 4, 5, 6, 7, 8, and 9.** First powerhouse A-branch diffusers are open according to the pattern in Table BON-9.

**11. First Powerhouse Collection Channel Diffusers.** Diffuser valves are operated according to the pattern in Table BON-10.

**Table BON-9. Bonneville Dam A-branch diffuser operating ranges.**

<b>Diffusers</b>	<b>Operating Range (Tailwater Elevation)</b>	<b>Dead Bands</b>
FG3-3	8.2' - 13.3'	7.8' - 8.2'
FG3-4	13.7' - 16.3'	13.3' - 13.7'
FG3-5	16.7' - 19.3'	16.3' - 16.7'
FG3-6	19.7' - 24.8'	19.3' - 19.7'
FG3-7	25.2' - 27.8'	24.8' - 25.2'
FG3-8	28.2' - 30.8'	27.8' - 28.2'
FG3-9	> 31.2'	30.8' - 31.2'

**Table BON-10. Bonneville Dam first powerhouse adult fish collection channel diffuser valve settings.**

<b>Valve</b>	<b>Setting</b>	<b>Valve</b>	<b>Setting</b>
FG2-1	Closed	FG2-13	Closed
FG2-2	Closed	FG2-14	Closed
FG2-3	Closed	FG2-15	Closed
FG2-4	Open	FG2-16	Closed
FG2-5	Closed	FG2-17	Closed
FG2-6	Closed	FG2-18	Closed
FG2-7	Closed	FG2-19	Open
FG2-8	Open	FG2-20	Open
FG2-9	Closed	FG2-21	Open
FG2-10	Closed	FG2-22A	Open
FG2-11	Closed	FG2-22B	Open
FG2-12	Open		

**d. Second Powerhouse.**

1. Operate all north (NUE and NDE) and south (SUE and SDE) entrances. Operate weir crests at elevation 1' (fully lowered) for tailwater elevations up to 14'. For tailwater elevations greater than 14', operate weir crest 13' or greater below tailwater.

2. Operate all 12 powerhouse floating gate fishway entrances.

**e. Spillway Operations.** Bonneville Dam uses a single spill schedule (Table BON-11) for both day and night. See section 2.2. Spill Management for guidance.

**2.5.2. Winter Operating Period, or In-water Work Period (December 1 through February).**

**2.5.2.1. Adult Fish Facilities.** Operate the adult fish passage facilities according to the fish passage period standards above, except systems may be dewatered or operated out of criteria for repair and maintenance.

**a.** Only one of the ladders servicing the two powerhouses and the associated powerhouse collection system (including the auxiliary water supply system) may be out of service or operating out of standard operating criteria at any one time unless specifically coordinated. Turbines will be operated in the priority outlined in section 2.1.1. during the winter maintenance period. One of the two ladders servicing the spillway channel will be in full operation at all times unless specially coordinated. Outage periods will be minimized to the extent practicable.

**b.** Adult facilities will be inspected once per day to assure operation as per criteria above. Project fish biologist and fish biological staff will conduct at least three inspections per week.

**c.** Spill bays 1 and 18 may be on seal throughout the winter operating period.

**d.** Adjust crowdors at fish counting stations to full open if video taping is temporarily discontinued due to unscheduled events or during the winter maintenance (dewatering) period only.

**2.6. Facility Monitoring and Reporting.**

**2.6.1. Inspections.** The project will inspect fish passage facilities at least twice per day to assure operation according to established criteria. More frequent inspections of some facility components will occur as noted throughout the text. The project fish biologist and fish biological staff will conduct at least three inspections per week. Additional fishway inspections may be performed by FFU and fish agencies.

**2.6.2. Zebra Mussel Monitoring.** A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and may become introduced into

the Columbia River basin. Inspections should also be made when dewatering all project facilities.

**2.6.3. Reporting.** Project biologists shall prepare weekly reports throughout the year summarizing project operations. The weekly reports will provide an overview of how the project and the fish passage facilities operated during the week and an evaluation of resulting fish passage conditions. The reports shall include: any out-of-criteria situations observed and subsequent corrective actions taken; any equipment malfunctions, breakdowns, or damage along with a summary of resulting repair activities; adult fishway control calibrations; STS and VBS inspections; AWS closures (i.e. cleaning times); times picket leads were lowered and raised in the Washington shore ladder when adult trapping is occurring in the adult fish collection and monitoring facility (AFC&MF); and any unusual activities which occurred at the project which may affect fish passage. The weekly reports shall cover a Sunday through Saturday time period and the Operations Manager shall send them to CENWP-OP and other interested parties as soon as possible the following week, with a copy to RCC, Attention: Fish Team. The reports may be delivered electronically. The project biologist shall prepare an annual report by January 31, summarizing the operation of the project fish passage facilities for the previous year. The report will cover from the beginning of one adult fish facility winter maintenance period to the beginning of the next. The annual report will be provided to CENWP-OP in time for distribution to FPOM members at the February meeting.

### **3. Fish Facilities Maintenance.**

#### **3.1. General.**

##### **3.1.1. Scheduled Maintenance.**

**3.1.1.1.** Staff gauges will be installed, cleaned, and/or repaired as required.

**3.1.1.2.** Scheduled fishway maintenance, to the extent practicable, will be conducted during periods when passage has been documented to be at its lowest during the regular scheduled workday, to minimize impacts to migrating salmonids. Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3.).

#### **3.2. Juvenile Fish Passage Facilities.**

##### **3.2.1. Scheduled Maintenance.**

**3.2.1.1. Submersible Traveling Screens.** The STS system will receive preventive maintenance or repair at all times of the year, including the winter maintenance period. Whenever a generator malfunctions or is scheduled for maintenance, the three STSs in that turbine may be maintained, repaired, or exchanged for other STSs needing maintenance or repair. One third of the STSs at Bonneville are scheduled for complete overhaul each year resulting in a three-year maintenance cycle unless future developments indicate that longer life expectancy is possible.

**3.2.1.2. Juvenile Bypass System.** The juvenile bypass facilities will receive preventive maintenance throughout the year. During the juvenile fish passage season this will normally be above-water work such as maintenance of automatic systems, air lines, electrical systems, and monitoring equipment. During the winter maintenance period, the systems may be dewatered downstream of the gatewell orifices. The systems will then be visually inspected in all accessible areas for damaged equipment and in areas that may cause problems to the juvenile fish. Any problem areas identified are to be repaired if the project is able. In extreme cases the work will be contracted as soon as possible or repaired during the next winter maintenance period. Modifications and general maintenance to the channels are also to be completed at this time.

The trash racks are to be raked just prior to the juvenile fish passage season and whenever trash accumulations are suspected because of increased head across the trash racks (>1.5') or increased juvenile fish descaling. Additional trash rack raking may be necessary when a storm brings large quantities of debris down river to the project. Gatewell orifices in the unit being raked will be closed during the procedure.

**3.2.1.3. Turbines and Spillways.** Maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires units to be shut down for extended periods of time (see section 5. Dewatering Plans). The maintenance schedules for these turbines and spillways will be coordinated with fish agencies through the FPOM. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to fishway entrances, to keep predator fish from accumulating near juvenile release sites, and to move juveniles downstream away from the project. The maintenance schedules for these turbines and spillways will reflect equal weighting given to fish, power, and water management and will be coordinated with the appropriate resource agencies. Units which should not be scheduled for maintenance during the fish passage season are F1, F2, 1, 2, 9, 10, 11, 17, and 18.

Some types of turbine maintenance will require testing the turbine throughout its full operating range before returning it to normal service. These operations will be coordinated with the appropriate resource agencies.

**3.2.2. Unscheduled Maintenance.** Maintenance of facilities such as fish screens, which sometimes break down during the fish passage season, will be carried out as described below. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with FPOM and NMFS on a case-by-case basis by project and CENWP-OP biologists. The CENWP-OP biologists will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Operations Manager has the authority to initiate work prior to notifying CENWP-OP when delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWP-OP includes:

- a. Description of the problem.
- b. Type of outage required.
- c. Impact on facility operation.
- d. Length of time for repairs.
- e. Expected impacts on fish passage.

**3.2.2.1. Submersible Traveling Screens.** If an STS or VBS is found to be damaged or inoperative in an operating unit, the unit will be regarded as an unscreened unit. The screen will be repaired or replaced before returning the unit to normal service.

**3.2.2.2. Juvenile Bypass System.** Juvenile bypass systems are controlled automatically (PLC). When an automatic system fails, it can usually be operated manually. This allows either facility to operate according to criteria while repair of the automatic system is completed. Orifices allow fish out of the gatewells into a bypass channel. If an orifice valve system becomes inoperative, it will be repaired expeditiously. When the orifices become plugged with debris they are pneumatically flushed. If the automatic systems fail and the system is operated manually, facility inspections should be increased to a frequency that assures these systems continue to operate within criteria.

All STS gatewells will be inspected daily and the project will clean them before they become half covered with debris. If, due to volume of debris, it is not possible to keep the gatewell surfaces at least half clear, they will be cleaned at least once

daily. Turbines with a gatewell fully covered with debris will not be operated, except on a last on/first off basis, if required to be in compliance with other coordinated fish measures. This is to maintain clean orifices and minimize fish injury. The gatewell orifices will be closed during the cleaning operation. Check gatewell drawdown.

**a. First Powerhouse.** If any part of the dewatering screen, downwell, or juvenile release conduit fails, making this portion of the system unsafe for juvenile fish, the juveniles will be diverted to the ice and trash sluiceway. This operating mode will require the gate at the south end of the DSM channel to be removed and a stop-log installed at the north end so migrants will flow down into the ice and trash sluiceway channel. Assure that sluiceway gate 7A is opened to 72' msl, gate 10C is opened fully, and the ice and trash sluiceway end gate is open to provide safe transportation flows for juveniles. Forebay elevation will be kept above 74' msl to the extent practicable. The bypass will then continue operating while repairs are completed. In either operating mode, the orifices will be cleaned with the air pressure system at least once per day, when plugged orifices are indicated, or after trash rack raking and gatewell debris removal.

**b. Second Powerhouse.** If the bypass system fails in the dewatering section or release pipe, fish may be released through the emergency relief conduit. This operation will continue until repairs are accomplished or until the end of the fish passage season. Any decision on whether or not to shut this system down for dewatering and repairs will be made in coordination with the FPOM. During this emergency operating mode, power generation will be minimized at the second powerhouse. Repairs will receive high priority.

**c.** During fishway inspections the VBSs may be found plugged or damaged. In these cases, the associated unit will be taken out of service as if unscreened and repairs will be made before returning the unit to normal service.

**3.2.2.3. Turbines and Spillways.** If a spill gate becomes inoperable, the operator will make the changes necessary to accommodate the spill and then immediately notify the operations supervisor and project biologist to determine the best pattern to follow until repairs are completed. This interim operation shall be coordinated with the FPOM through the district biologist who will provide additional guidance to the project.

**3.2.2.4. Diffuser Gratings:** Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods.

Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passage way and physically inspecting the diffuser gratings, or by using underwater video cameras and divers or other methods to inspect the gratings. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes which may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffusers gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

### **3.3. Adult Fish Passage Facilities.**

**3.3.1. Scheduled Maintenance.** Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3).

**3.3.1.1. Fishway Auxiliary Water Systems.** Bonneville Project auxiliary water systems consist of gravity flow and hydroelectric generating systems. Preventive maintenance and normal repair are carried out as needed throughout the year. Trash racks for the AWS intakes will be raked when drawdown exceeds criteria. When practicable, rake trash racks during the time of day when fish passage is least affected.

**3.3.1.2. Powerhouse and Spillway Adult Fish Collection Systems.** Preventive maintenance and repair occurs throughout the year. During the primary adult fish passage season this maintenance will not involve any operations which will cause failure to comply with the adult fishway criteria except as specially coordinated or as needed for semi-annual maintenance. Inspection of those parts of the adult collection channel systems which require dewatering, such as diffusion gratings, leads, and entrance gates, will be scheduled once per year during the winter maintenance season while the system is dewatered, with one additional inspection during the fish passage season, unless a channel must be dewatered for fishway modifications or to correct observed problems (see section 5. Dewatering Plans.). A diver or underwater video system may be used for the underwater inspections. This scheduled inspection and any associated maintenance will occur during the winter maintenance period (in-

water work period) unless specially coordinated. Any non-routine maintenance and fishway modifications will be handled on a case by case basis.

A project biologist or alternate Corps fish personnel will attend all dewatering activities potentially involving fish, as well as inspections, to provide fish-related input (see section 5. Dewatering Plans).

**3.3.1.3. Adult Fish Ladders and Counting Stations.** The adult fish ladders will be dewatered once each year during the winter maintenance period. During this time, the ladders will be inspected for blocked orifices, projections into the fishway that may injure fish, stability of the weirs, damaged picket leads, exit gate problems, loose diffusion gratings, unreadable or damaged staff gauges, defective diffusion valves, and malfunctioning operating equipment at the counting stations, as well as other potential problems. Problems identified throughout the passage year that do not affect fish passage, as well as those identified during the dewatered period, may then be repaired. Trash racks at the ladder exits will be raked when criteria is approached or exceeded. When practicable, rake trash racks during the time of day when fish passage is least affected. Fish count station windows, light panels, and crowder panels will be cleaned as needed to achieve accurate counts and, when practicable, during the time of day when fish passage is least affected.

**3.3.2. Unscheduled Maintenance.** Maintenance activities that occur during the fish passage period and that may affect fish passage will be reported in the weekly reports (section 2.6.3.). Unscheduled maintenance that will significantly affect the operation of a facility, such as repair of displaced diffuser gratings, will be coordinated with the CBFWA (through the FPC) and NMFS. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities (section 3.2.2).

**3.3.2.1. Fishway Auxiliary Water Systems.** Most fishway auxiliary water systems are operated automatically. If the automatic system fails, then the system will be manually operated by project personnel to maintain criteria while repair of the automatic system is carried out. When this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met. In the event of AWS failure, FPOM will be used in an advisory capacity to assist the project as needed.

**a. First Powerhouse.** If any of the valves or any other part of the system fails, then the project is to attempt to

maintain criteria by adjusting those valves which continue to function. Conduit pressure must be monitored and not allowed to exceed the established limits. If this maneuver fails to keep the facility operating according to the adult fishway criteria and repairs cannot be made within 24 hours, then close powerhouse entrances 9, 21, 34, 58, and 62, one at a time, starting with gate 9 and proceeding north.

If closing the orifice gate fails to achieve a minimum fishway head of 1' when tailwater is greater than 17' msl, then operation of gate 1 and gate 65 weirs becomes necessary. Operational guidelines of these gates appear in section 2.5.1.2.c.

When tailwater elevation is less than 17' and the gate 65 weir crest is at least 6' below tailwater, then operation of gates 1, 2, 64, and 65 becomes necessary. Operational guidelines of these gates appear in section 2.5.1.2.c.

**b. Spillway.** Two separate fishway auxiliary water valves add water to each spillway ladder (Cascades Island and B-branch ladders). If one of these valves or any other part of the system malfunctions, the functioning parts of the system are to be adjusted to compensate. If repairs cannot be made in 24 hours, close the sluice gate entrance, if open. This will divert the reduced available water to the entrance slots. If a head of 1' is still not achieved, stoplogs are to be added to the entrance slots until the desired head or a weir depth of not less than 6' below the tailwater surface is reached. At this point maintain the gate positions until the auxiliary water system is repaired.

**c. Second Powerhouse.**

1. If either or both of the fishway auxiliary water turbines are unable to provide water sufficient to meet full criteria between April 1 and August 31, the adult facilities will be operated as follows or until a fishway head of 1' is achieved.

(a) Raise the NUE in 1' increments until weir crest is 8' below tailwater or a fishway head of at least 1' is achieved.

(b) Raise the SUE in 1' increments until weir crest is 8' below tailwater or a fishway head of at least 1' is achieved.

(c) Raise the SDE in 1' increments until weir

crest is 8' below tailwater or a fishway head of at least 1' is achieved.

(d) Raise the NDE in 1' increments until weir crest is 8' below tailwater or a fishway head of at least 1' is achieved.

(e) Raise the NUE in 1' increments until weir crest is 6' below tailwater or a fishway head of at least 1' is achieved.

(f) Raise the SUE in 1' increments until weir crest is 6' below tailwater or a fishway head of at least 1' is achieved.

(g) Raise the SDE in 1' increments until weir crest is 6' below tailwater or a fishway head of at least 1' is achieved.

(h) Raise the NDE in 1' increments until weir crest is 6' below tailwater or a fishway head of at least 1' is achieved.

(i) Close the NUE.

(j) Close the SUE.

2. If one of the fishway water supply turbine units fails between September 1 and March 31, during a time when tailwater is high enough that normal operation can't be maintained using the remaining fish unit, and repairs can't be made within 24 hours, then the ice and trash sluiceway will be used to supplement discharge to allow operation of the fishway according to the above standards. Between September 1 and 15, and between March 1 and 31, the juvenile and adult runs will be evaluated to decide if the sluice chute should be operated when one fish unit is out of service. Care will be taken to keep the trash chute screen free of debris. When the ice and trash chute is operated as supplemental discharge, a barrier rack will be used at the entrance to the ice and trash chute to exclude adult salmonids. Under this operation, the ice and trash chute downstream end gate will be raised briefly at least once weekly to flush trapped juvenile salmonids, smaller resident fish, and debris out of the chute. If the rack is not used, the chute will be flushed twice weekly, on Monday and Thursday, or more frequently if needed. Frequency of use during peak adult passage season (September to early October) will be coordinated with FPOM.

3. If both of the fishway auxiliary water turbines fail between September 1 and March 31, and repairs can not be made within 8 hours, then the ice and trash chute will be started. The adult facilities will be operated as follows or until a fishway head of 1' is achieved.

(a) Close the NUE and SUE.

(b) Operate the SDE and NDE weir crest at 8' below tailwater or until a fishway head of at least 1' is achieved.

(c) Operate the SDE and NDE weir crest at 6' below tailwater or until a fishway head of at least 1' is achieved.

(d) Close the SDE.

(e) If the back-up auxiliary water system must be used for a period exceeding 30 days, then block off as many of the floating orifice gates as possible beginning in the center and proceeding north and then south and open the SDE and NDE to a weir depth of 8' below tailwater. While under this configuration, power generation at the second powerhouse will be minimized to reduce fish attraction into this area.

4. If all auxiliary water systems fail or malfunction, close the NUE, SUE, and SDE and raise the NDE weir crest to 6' below tailwater with the floating orifice gates open. Maintain this configuration until the system is repaired. While under this configuration, power generation at the second powerhouse will be minimized to the extent practicable to reduce fish attraction into this area unless the first powerhouse facilities are dewatered.

d. Second powerhouse adult fishway diffusion system valves A3 and A4 were found damaged and have been removed. These valves were designed to be closed when tailwater drops below 11' and 9', respectively. Even though the valves cannot be closed, velocity in the channel has remained in criteria.

#### **3.3.2.2. Powerhouse and Spillway Adult Fish Collection Systems.**

Bonneville Project contains several types of fishway entrances. In most cases, if failures occur, the entrance can and will be operated manually by project personnel until repairs are made. If this operation becomes necessary, project personnel will increase the surveillance of the adult system to ensure that criteria are being met. In those cases in which the failure will not allow the entrance to be operated manually, the gate will be

maintained, to the extent possible, in an operational position. If this is not possible, the entrance will be repaired expediently and returned to manual or automatic control at the earliest possible date.

**3.3.2.3. Adult Fish Ladders and Counting Stations.** The first powerhouse ladder was completed in 1937 and the second powerhouse ladder in 1981. Modification of the first powerhouse ladder was completed during the winter of 1981-82. The components of the ladders include picket leads, counting stations, fishway exits, and overflow weirs with orifices. Picket leads can cause problems. Pickets with excessive spacing (greater than 1"), concrete erosion around the leads, or missing pickets can allow fish into areas where escape is difficult. In some instances of picket lead failure, spare leads and spare installation slots are available. In these cases the spare leads are installed and the damaged leads are removed and repaired. In the remaining instances of picket lead failure or concrete erosion, the timing and method of repair will depend upon the severity of the problem. The decision of whether or not to dewater the fishway and repair any problems will be made in coordination with FPOM.

**3.3.2.4. Diffuser Gratings.** Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passage way and physically inspecting the diffuser gratings, or by using underwater video cameras and divers or other methods to inspect the gratings. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes which may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffusers gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

#### **4. Turbine Unit Operation and Maintenance.**

**4.1.** Unit operating priority throughout the year is shown in

section 2.1.1, Powerhouse Flow Distribution. Operating the end units provides attraction flow for adult fish at both powerhouses and helps move juvenile fish out of the first powerhouse tailrace.

**4.2.** Turbine units will operate within 1% of best efficiency and within cavitation limits at various head ranges as shown in Tables BON-11 through BON-13 for both powerhouses. Operating ranges for the first powerhouse (Tables BON-11 and BON-12) do not include the influence of the prototype surface collector or ESBSS which have been installed to conduct fish passage studies. Also, first powerhouse units 4 and 6 have different MW output requirements because they are minimum gap runner units and have a different MW versus discharge relationship.

**4.3.** To the extent technically feasible, turbines will be operated within +/-1% of best turbine efficiency, unless operation outside of that range is necessary to meet load requests from the BPA administrator, consistent with BPA's System Load Shaping Guidelines (Appendix C), to avoid excess daytime spill (during the time of year when the 75 kcfs spill cap applies), or to comply with other coordinated fish measures. The guidelines apply between March 15 and October 31. However, during the rest of the year, the project will continue to operate units within the 1% turbine efficiency range, except as specifically requested by BPA to do otherwise as provided in Appendix C.

**4.4.** If it is necessary to operate outside the +/- 1% efficiency range, then units which pass the least fish should be selected first. Assuming a preference to pass fish through the juvenile bypass system, units which pass the least fish will be selected first. Therefore, when units must be selected to operate outside the 1% efficiency range, they will be chosen according to the following prioritized list, when not constrained by specific project limitations: (5-8), 3, 9, 10, 2, 1, 15, 14, 13, 16, 12, 17, 11, 18.

**Table BON-11. Turbine operating ranges within the 1% turbine efficiency range for Bonneville first powerhouse, units 1-3, 5, and 7-10.**

		First Powerhouse (units 1-3, 5, 7-10)							
		With STS				Without STS			
Head (feet)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	
35	12.7	5,285	29.2	12,107	13.2	5,385	31.0	12,620	
36	13.3	5,345	30.3	12,212	13.7	5,409	32.3	12,716	
37	13.8	5,401	31.5	12,310	14.2	5,431	33.5	12,803	
38	14.4	5,453	32.7	12,401	14.7	5,450	34.8	12,882	
39	14.9	5,501	33.8	12,486	15.2	5,466	36.0	12,954	
40	15.1	5,377	35.1	12,485	15.7	5,481	37.3	13,020	
41	15.6	5,422	36.2	12,557	16.3	5,5282	38.5	13,095	
42	16.2	5,464	37.4	12,623	16.8	5,571	39.8	13,165	
43	16.7	5,504	38.6	12,685	17.4	5,612	41.0	13,230	
44	17.3	5,541	39.7	12,743	18.0	5,650	42.3	13,291	
45	17.8	5,576	40.9	12,796	18.5	5,685	43.5	13,347	
46	18.4	5,633	41.8	12,769	19.2	5,743	44.4	13,319	
47	19.1	5,687	42.7	12,742	19.8	5,798	45.4	13,292	
48	19.7	5,738	43.6	12,716	20.4	5,851	46.3	13,265	
49	20.3	5,786	44.5	12,690	21.1	5,900	47.3	13,238	
50	20.9	5,832	45.4	12,664	21.7	5,947	48.2	13,211	
51	21.7	5,923	46.1	12,587	22.5	6,041	49.0	13,131	
52	22.5	6,011	46.8	12,512	23.3	6,130	49.8	13,075	
53	23.2	6,095	47.4	12,440	24.2	6,216	50.6	13,020	
54	24.0	6,174	48.1	12,370	25.0	6,297	51.4	12,966	
55	24.8	6,251	48.8	12,302	25.8	6,376	51.9	12,836	
56	25.3	6,2626	50.1	12,400	26.3	6,387	53.3	12,938	
57	25.8	6,273	51.3	12,495	26.8	6,398	54.6	13,036	
58	26.3	6,284	52.6	12,587	27.3	6,409	55.9	13,132	
59	26.7	6,294	53.8	12,676	27.8	6,420	57.2	13,225	
60	27.2	6,305	55.1	12,762	28.3	6,430	58.6	13,315	
61	27.6	6,298	56.2	12,810	28.7	6,423	59.7	13,365	
62	28.0	6,292	57.2	12,857	29.1	6,417	60.9	13,413	
63	28.4	6,286	58.3	12,903	29.5	6,411	62.0	13,461	
64	28.4	6,281	59.4	12,947	29.9	6,405	63.1	13,507	
65	29.2	6,275	60.5	12,991	30.4	6,399	64.3	13,553	
66	29.9	6,328	61.3	12,986	31.0	6,453	65.1	13,547	
67	30.5	6,379	62.1	12,981	31.7	6,505	66.0	13,541	
68	31.2	6,429	62.9	12,977	32.4	6,556	66.9	13,537	
69	31.8	6,478	63.7	12,947	33.1	6,606	67.8	13,533	
70	32.5	6,526	64.5	13,968	33.8	6,654	68.6	13,529	

**Table BON-12. Turbine operating ranges within the 1% turbine efficiency range for Bonneville first powerhouse, units 4 and 6.**

Head (feet)	First Powerhouse (units 4 and 6)							
	STS				Without STS			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
35	17.5	6,761	24.3	9,386	18.9	7,246	24.4	9,365
36	18.1	6,776	25.1	9,406	19.5	7,250	25.2	9,368
37	18.7	6,790	25.9	9,424	20.1	7,252	26.0	9,370
38	19.2	6,803	26.7	9,440	20.7	7,253	26.8	9,369
39	19.8	6,814	27.5	9,455	21.4	7,253	27.6	9,368
40	20.4	6,764	28.2	9,384	22.0	7,251	28.4	9,364
41	20.9	6,770	29.4	9,519	22.6	7,257	29.5	9,499
42	21.5	6,775	30.6	9,646	23.2	7,263	30.7	9,626
43	22.0	6,779	31.7	9,766	23.8	7,267	31.9	9,746
44	22.6	6,783	32.9	9,880	24.4	7,271	33.0	9,860
45	23.1	6,786	34.0	9,988	25.0	7,274	34.2	9,967
46	23.7	6,789	35.0	10,031	25.6	7,278	35.1	10,010
47	24.2	6,793	35.9	10,071	26.2	7,282	36.1	10,050
48	24.8	6,795	36.9	10,109	26.8	7,285	37.1	10,088
49	25.4	6,798	37.8	10,145	27.4	7,287	38.0	10,124
50	25.9	6,799	38.8	10,178	28.0	7,289	39.0	10,157
51	26.5	6,802	39.8	10,221	28.6	7,293	40.0	10,201
52	27.0	6,805	40.8	10,262	29.2	7,296	40.5	10,145
53	27.6	6,808	41.7	10,301	29.8	7,298	41.1	10,092
54	28.1	6,810	42.7	10,339	30.4	7,301	41.7	10,040
55	28.7	6,811	43.7	10,374	31.0	7,302	43.9	10,353
56	29.2	6,816	44.7	10,433	31.5	7,308	44.9	10,412
57	29.8	6,821	45.8	10,489	32.1	7,312	46.0	10,468
58	30.3	6,825	46.9	10,544	32.7	7,317	47.1	10,523
59	30.9	6,829	47.9	10,596	33.3	7,322	48.1	10,575
60	31.4	6,833	49.0	10,647	33.9	7,326	49.2	10,626
61	32.0	6,843	49.6	10,609	34.5	7,337	49.8	10,587
62	32.6	6,853	50.3	10,572	35.2	7,347	50.5	10,551
63	33.2	6,863	50.9	10,536	35.8	7,358	51.2	10,515
64	33.8	6,872	51.6	10,501	36.4	7,367	51.8	10,480
65	34.4	6,881	52.3	10,467	37.1	7,377	52.5	10,446
66	34.8	6,872	53.2	10,502	37.6	7,368	53.4	10,481
67	35.3	6,864	54.1	10,535	38.1	7,360	54.4	10,514
68	35.7	6,857	55.1	10,569	38.6	7,351	55.3	10,547
69	36.2	6,850	56.0	10,601	39.1	7,344	56.3	10,580
70	36.7	6,643	57.0	11,451	39.6	7,336	57.2	10,611

**Table BON-13. Turbine operating ranges within the 1% turbine efficiency range for Bonneville second powerhouse, with or without STSS in place.**

Head (feet)	Second Powerhouse (units 11-18)			
	Lower Limit (MW)	Lower Limit (cfs)	Upper Limit (MW)	Upper Limit (cfs)
34	29	12,047	39	16,478
35	29	12,055	40	16,578
36	30	12,063	41	16,578
37	31	12,070	43	16,627
38	32	12,078	44	16,677
39	33	12,086	45	16,727
40	34	12,044	47	16,777
41	35	12,022	49	16,826
42	36	11,960	51	16,876
43	37	11,918	53	16,926
44	38	11,881	55	17,008
45	39	11,844	56	17,090
46	39	11,807	58	17,173
47	40	11,770	59	17,255
48	41	11,733	61	17,337
49	42	11,747	63	17,338
50	43	11,760	65	17,338
51	44	11,774	66	17,339
52	45	11,787	68	17,339
53	46	11,801	70	17,340
54	47	11,842	72	17,340
55	48	11,884	73	17,341
56	49	11,925	75	17,342
57	51	11,967	76	17,342
58	52	12,008	77	17,343
59	53	12,050	77	17,343
60	54	12,091	77	17,344
61	55	12,103	77	16,967
62	56	12,115	77	16,590
63	57	12,128	77	16,214
64	58	12,140	77	15,837
65	59	12,152	77	15,460
66	60	12,164	77	15,083
67	61	12,176	77	14,706
68	62	12,189	77	14,330
69	63	12,201	77	13,953
70	64	12,213	77	13,576

**4.5.** The project turbine unit maintenance schedules will be reviewed by Project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. See section 3.2.1.3.

**4.5.1.** Unit 10 provides important attraction flow for adult fish and helps move juvenile fish out of an area of high predation in the tailrace. Therefore, long-term outages will be avoided after the beginning of the juvenile fish passage season, particularly the first Spring Creek NFH fish release, until after the adult fall chinook and coho runs at the end of October.

**4.5.2.** Unit 1 provides important attraction flow for adult fish, and, when the juvenile bypass system flow is reversed, it also helps move juvenile fish downstream. Therefore, long-term outages will be avoided after the beginning of the juvenile fish passage season, particularly the first Spring Creek NFH fish release, until after the adult fall chinook and coho runs at the end of October.

**4.5.3.** In the event of long-term outages at Bonneville powerhouses, affected units will be exercised periodically. Each unit will be operated 4-8 hours every two weeks to exercise governor components and clean wetted surfaces of corrosion, so that if needed, fish injury will be minimized and the units will be in good operating condition. This may be performed at night, daytime, or whenever unit cycling will have the least effect on fish passage.

**4.6.** Until problems with the second powerhouse hydraulic head gate operating system are corrected, the gates at units 11 through 18 will be set onto the latches. Oil leaks develop frequently when the system operates with normal pressure. Further related instructions are described in a memorandum from the project operations superintendent. (Memorandum for All Operations, from BON Chief of Operations, dated September 23, 1993. Subject: Powerhouse 2 Hydraulic Head Gate Operation).

## **5. Dewatering Plans.**

**5.1.** Guidelines for Dewatering and Fish Handling Plans (Appendix G) have been developed and are followed for most project facilities dewaterings. These plans include consideration for fish safety and are consistent with the following general guidance. The appropriate plans are reviewed by participants before each salvage operation. Although it isn't a complete

dewatering, the procedure for reversing flow in the first powerhouse DSM is also included in Appendix G.

**5.2.** A project biologist and/or alternate Corps fish personnel will attend all project activities involving fish handling.

**5.3.** The fish agencies and tribes will be invited to assist in any dewatering and, at a minimum, are invited to participate in all ladder dewaterings.

**5.4. Juvenile bypass systems.** Key elements of the Guidelines for Dewatering and Fish Handling Plans (Appendix G) for JBS flow reversal are shown in sections 5.4.1. through 5.4.5., below.

**5.4.1.** A project biologist will attend all activities which involve dropping the JBS water surface below the end of the dewatering screen. Refer to the project Fish Salvage Plan for descriptions of JBS dewaterings. (The plan is available from project biologists).

**5.4.2.** Personnel involved in use of the sampling facilities will be advised before facilities are drained.

**5.4.3.** Automatic controls for the trash sweeps will be turned off.

**5.4.4.** Flow through the dewatering screen will be reduced before the water level drops below the upper end of the screen. Refer to the Fish Salvage Plan.

**5.4.5.** The area beneath the dewatering screen will be filled before allowing water in the channel to rise to the elevation of the dewatering screen.

**5.5. Adult Fish Ladder.**

**5.5.1. Scheduled Maintenance.**

**5.5.1.1.** When possible, operate the ladder to be dewatered at a reduced flow for at least 24 hours, and up to 96 hours, prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow. This operation shall not be initiated prior to 1800 hours on November 30<sup>th</sup> if a ladder outage is scheduled for December 1<sup>st</sup>.

**5.5.1.2.** Discontinue all fishway auxiliary water supply at least 24 hours, but no more than 96 hours, prior to dewatering. This operation shall not be initiated until 1800 hours on November 30<sup>th</sup> if a ladder outage is scheduled for December 1<sup>st</sup>.

**5.5.1.3.** A project biologist will assure that fish rescue equipment is available and will coordinate to assure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

**5.5.1.4.** Project personnel will install head gates to shut down ladder flow. Where possible, a minimum flow depth of 1" - 2" will be maintained in the ladder until fish are rescued.

**5.5.1.5.** A project biologist or alternate Corps fish personnel will oversee fish rescue when the ladders are dewatered. The project biologist will invite fish agency and/or tribal biologists to participate in the dewatering. Rescue personnel will walk the inside of the ladder from the head gates down to tailwater, salvaging all fish either by moving fish to tailwater within the ladder flow, or capturing and placing the fish in a large water-filled tank, which is then transported to the forebay or tailrace for release. Adult fish will be released into the forebay and juvenile fish will be released into the tailrace. If a ladder is dewatered in the spring or summer, steelhead kelts will be released into the tailrace.

**5.5.1.6.** Orifice blocking devices which are placed in the lower-most weirs to prevent fish from re-ascending the dewatered portion of the adult fishway shall have ropes placed on them to be tied to fishway railings. The orifice blocks shall be removed just before the fishway is returned to service. The ropes will help identify and prevent the orifice blocks from being accidentally left in place after fishway water-up. The orifice blocking devices will appear on the pre-water-up checklist maintained by the project biologist.

## **5.5.2. Unscheduled Maintenance.**

**5.5.2.1.** When possible, discontinue fishway auxiliary water and operate the ladder at orifice flow as long as possible (prefer 3-24 hours) prior to dewatering.

**5.5.2.2.** Follow guidance in sections 5.5.1.3. through 5.5.1.5. above.

## **5.6. Powerhouse Fish Collection System.**

### **5.6.1. Scheduled Maintenance.**

**5.6.1.1.** During the pumping or draining operation to dewater a portion or all of the collection channel, the water level will not be allowed to drop to a level which strands fish. Adequate

inspections will be conducted to ensure that stranding does not occur.

**5.6.1.2.** A project biologist will assure that rescue equipment and adequate personnel are available if needed.

**5.6.1.3.** A project biologist will provide technical guidance to assure fish safety and will assist directly as needed in rescue operations.

## **5.7. Turbines.**

**5.7.1.** Immediately before setting the head gates, remove juvenile fish from the gatewell(s) which will be drained. This is done by use of a special dipping basket. Typically, one of the three gatewells is drained to allow ventilation into the draft tube.

**5.7.2.** When possible, place head gates and tail logs immediately after a turbine unit is shut down if the draft tube is to be dewatered. This is necessary for both scheduled and unscheduled outages.

**5.7.3.** If a turbine unit draft tube is to be dewatered and the turbine unit has been idle, it will be operated when possible at speed/no load and stop logs will then be placed immediately.

**5.7.4.** Water levels in the draft tube will not be allowed to drop to a level which strands fish. Adequate inspections will be conducted to ensure that stranding does not occur.

**5.7.5.** Fish rescue personnel will inspect dewatered turbine draft tubes, scroll cases, and intakes as soon as the water levels reach a depth permitting visual inspection and the hatch cover is opened. A project biologist and/or alternate Corps fish personnel will provide technical guidance for fish safety and will directly participate in fish salvage.

**5.7.6.** A project biologist will invite FPOM members to participate in the dewatering, and will assure that rescue equipment is available if needed.

**5.7.7.** If the unit is planned to be out of service and partially drained for less than 4 days and low numbers of fish are trapped, then it will not be necessary to remove fish from draft tubes as long as an adequate safety pool is maintained. Adequate inspections will be conducted to ensure the safety pool is maintained and fish are in good condition.

**6. Forebay Debris Removal.** Debris can impact fish passage conditions in several ways. It can plug or block trash racks, VBSs, gatewell orifices, dewatering screens, and facility piping, resulting in impingement, injuries, and descaling of fish. Debris is removed by operating the ice and trash sluiceway at the first powerhouse, the ice and trash chute at the second powerhouse, or passing it through the spillway with special spill gate operation.

Special spill operations that don't follow the normal spill schedule or volume limits will be coordinated prior to their execution. Normally, the project shall contact CENWP-OP at least two work days prior to the day the special operation is required. Using information provided by the project, CENWP-OP will coordinate with RCC, NMFS, and other FPOM members as necessary. Once the coordination is complete, RCC will issue a teletype detailing the specifics of the special operations.

**7. Response to Hazardous Materials Spills.** Bonneville Project's guidance for responding to hazardous substance spills is contained in its Emergency Spill Response Plan. This guidance will be followed in case of a spill. The project biologist will be contacted as soon as possible after a hazardous material release. The project biologist will in turn contact the CENWP-OP biologist, NMFS, and FPC.

Table BON-14. Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18				
4"	1																4"	1	3.1		
4"	1																1	4"	2	6.2	
4"	1	1															1	4"	3	9.3	
4"	1	1														1	1	4"	4	12.4	
4"	1	1	1													1	1	4"	5	15.5	
4"	1	1	1												1	1	1	4"	6	18.6	
4"	1	1	1	1											1	1	1	4"	7	21.7	
4"	1	1	1	1											1	1	1	4"	8	24.8	
4"	1	2	1	1											1	1	1	4"	9	28.5	
4"	3	2										2					1	2	4"	10	33.6
4"	3	2										2					2	2	4"	11	37.2
4"	3	2				1						2					2	2	4"	12	40.3
4"	3	2				2						2					2	2	4"	13	43.9
4"	3	2	1			2						2					2	2	4"	14	47.0
4"	3	2	1			2						2				1	2	2	4"	15	50.1
4"	3	2	1			2				1		2				1	2	2	4"	16	53.2
4"	3	2	1			2				2		2				1	2	2	4"	17	56.9
4"	3	2	2			2				2		2				1	2	2	4"	18	60.5
4"	3	2	2			2		1		2		2				1	2	2	4"	19	63.6
4"	3	2	2			2		2		2		2				1	2	2	4"	20	67.2
4"	3	2	2			2		2		2		2				1	1	2	4"	21	70.3
4"	3	2	2			2		2		2		2				2	1	2	4"	22	74.0
4"	3	2	2			2		2		2		2				2	1	2	4"	23	77.5
4"	3	2	2			2		2		2		2				2	2	2	4"	24	81.1
4"	3	3	2			2		2		2		2				2	2	2	4"	25	84.6
4"	3	3	2			2		2	1	2		2				2	2	2	4"	26	87.7
4"	3	3	2			2		2	2	2		2				2	2	2	4"	27	91.4
4"	4	3	2			2		2	2	2		2				2	2	2	4"	28	94.9
4"	4	3	2			2		2	2	2		2				2	2	3	4"	29	98.4
4"	4	3	2			2		2	2	2		2				2	2	3	4"	30	102
4"	4	3	3			2		2	2	2		2				2	2	3	4"	31	105
4"	4	3	3	1		2		2	2	2		2				2	2	3	4"	32	109
4"	4	3	3	2		2		2	2	2		2				2	2	3	4"	33	112
4"	4	3	3	2		2		2	2	2		2				2	2	3	4"	34	115
4"	4	3	3	2		2		2	2	2		2				2	2	3	4"	35	119
4"	4	3	3	2		2		1	2	2		2				2	2	3	4"	36	122
4"	4	3	3	2		2		2	2	2		2				2	2	3	4"	37	126
4"	4	3	3	2		2		2	2	2		2				2	2	3	4"	38	129
4"	4	3	3	2		2		2	2	2		2				2	2	3	4"	39	132
4"	4	4	3	2		2		2	2	2		2				2	2	3	4"	40	136
4"	4	4	3	2		2		2	2	2		2				2	2	3	4"	41	139
4"	4	4	3	2		2		2	2	2		2				2	2	4	4"	42	143
4"	4	4	3	3		2		2	2	2		2				2	2	4	4"	43	146
4"	4	4	3	3		2		2	2	2		2				2	2	4	4"	44	150
4"	4	4	3	3		2		2	2	2		2				2	2	4	4"	45	153

Table BON-14 (cont). Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	4	4	3	3	2	3	2	2	2	2	3	2	3	3	4	4	4"	46	157
4"	4	4	3	3	2	3	2	2	3	2	3	2	3	3	4	4	4"	47	160
4"	4	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	48	164
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	4	4"	49	167
4"	5	4	3	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	50	171
4"	5	4	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	51	174
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	4	5	4"	52	178
4"	5	5	4	3	2	3	2	3	3	2	3	2	3	3	5	5	4"	53	181
4"	5	5	4	3	2	3	2	3	3	3	3	2	3	3	5	5	4"	54	185
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	3	5	5	4"	55	188
4"	5	5	4	3	2	3	3	3	3	3	3	2	3	4	5	5	4"	56	192
4"	5	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	57	195
4"	5	5	4	4	2	3	3	3	3	3	3	2	3	4	5	5	4"	57	195
4"	5	5	5	4	3	3	3	3	3	3	3	2	3	4	5	5	4"	59	202
4"	5	5	5	4	3	3	3	3	3	3	3	3	3	4	5	5	4"	60	206
4"	5	5	5	4	3	4	3	3	3	3	3	3	3	4	5	5	4"	61	209
4"	5	5	5	4	3	4	3	3	3	3	4	3	3	4	5	5	4"	62	213
4"	5	5	5	4	4	4	3	3	3	3	4	3	3	4	5	5	4"	63	216
4"	5	5	5	4	4	4	3	4	3	3	4	3	3	4	5	5	4"	64	220
4"	5	5	5	4	4	4	3	4	3	3	4	3	4	4	5	5	4"	65	223
4"	5	5	5	4	4	4	3	4	4	3	4	3	4	4	5	5	4"	66	227
4"	5	5	5	4	4	4	3	4	4	3	4	3	4	5	5	5	4"	67	230
4"	5	5	5	4	4	4	3	4	4	4	4	3	4	5	5	5	4"	68	234
4"	5	5	5	4	4	4	3	4	4	4	4	4	4	5	5	5	4"	69	237
4"	5	5	5	5	4	4	3	4	4	4	4	4	4	5	5	5	4"	70	241
4"	5	5	6	5	4	4	3	4	4	4	4	4	4	5	5	5	4"	71	244
4"	5	5	6	5	4	4	4	4	4	4	4	4	4	5	5	5	4"	72	248
4"	5	5	6	5	4	4	4	4	4	4	4	4	4	6	5	5	4"	73	251
4"	5	5	6	5	4	5	4	4	4	4	4	4	4	6	5	5	4"	74	255
4"	5	5	6	5	4	5	4	4	4	4	4	4	5	6	5	5	4"	75	258
4"	5	5	6	5	4	5	4	4	4	4	5	4	5	6	5	5	4"	76	262
4"	5	5	6	5	5	5	4	4	4	4	5	4	5	6	5	5	4"	77	265
4"	5	5	6	6	5	5	4	4	4	4	5	4	5	6	5	5	4"	78	268
4"	5	5	6	6	5	5	4	5	4	4	5	4	5	6	5	5	4"	79	272
4"	5	5	6	6	5	5	4	5	4	5	5	4	5	6	5	5	4"	80	275
4"	5	5	6	6	5	5	4	5	5	5	5	4	5	6	5	5	4"	81	279
4"	5	5	6	6	5	5	4	5	5	5	5	5	5	6	5	5	4"	82	282
4"	5	5	6	6	5	5	5	5	5	5	5	5	5	6	5	5	4"	83	286
4"	5	5	6	6	5	6	5	5	5	5	5	5	5	6	5	5	4"	84	289
4"	5	5	6	6	5	6	5	5	5	5	5	5	6	6	5	5	4"	85	292
4"	5	5	6	6	5	6	5	5	5	5	6	5	6	6	5	5	4"	86	296
4"	5	5	6	6	6	6	5	5	5	5	6	5	6	6	5	5	4"	87	299
4"	5	5	6	6	6	6	5	6	5	5	6	5	6	6	5	5	4"	88	302
4"	5	5	6	6	6	6	5	6	6	5	6	5	6	6	5	5	4"	89	306
4"	5	5	6	6	6	6	5	6	6	6	6	5	6	6	5	5	4"	90	309

Table BON-14 (cont). Spill patterns for Bonneville Dam.

Bay Number																		Total Dogs	kcfs
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	5	5	6	6	6	6	5	6	6	6	6	6	6	6	5	5	4"	91	312
4"	5	5	6	6	6	6	6	6	6	6	6	6	6	6	5	5	4"	92	316
4"	5	5	6	6	6	7	6	6	6	6	6	6	6	6	5	5	4"	93	319
4"	5	5	6	6	6	7	6	6	6	6	6	6	7	6	5	5	4"	94	323
4"	5	5	6	6	6	7	6	6	6	6	7	6	7	6	5	5	4"	95	326
4"	5	5	6	6	7	7	6	6	6	6	7	6	7	6	5	5	4"	96	330
4"	5	5	6	6	7	7	6	7	6	6	7	6	7	6	5	5	4"	97	333
4"	5	5	6	6	7	7	6	7	7	6	7	6	7	6	5	5	4"	98	336
4"	5	5	6	6	7	7	6	7	7	7	7	6	7	6	5	5	4"	99	340
4"	5	5	6	6	7	7	7	7	7	7	7	6	7	6	5	5	4"	100	343
4"	5	5	6	6	7	7	7	7	7	7	7	7	7	6	5	5	4"	101	347
4"	5	5	6	7	7	7	7	7	7	7	7	7	7	6	5	5	4"	102	350
4"	5	5	6	7	7	7	7	8	7	7	7	7	7	6	5	5	4"	103	353
4"	5	5	6	7	7	7	7	8	8	7	7	7	7	6	5	5	4"	104	357
4"	5	5	6	7	7	7	8	8	8	7	7	7	7	6	5	5	4"	105	360
4"	5	5	6	7	7	7	8	8	8	8	7	7	7	6	5	5	4"	106	363
4"	5	5	6	7	7	8	8	8	8	8	7	7	7	6	5	5	4"	107	367
4"	5	5	6	7	7	8	8	8	8	8	8	7	7	6	5	5	4"	108	370
4"	5	5	6	7	8	8	8	8	8	8	8	7	7	6	5	5	4"	109	373
4"	5	5	6	7	8	8	8	8	8	8	8	8	7	6	5	5	4"	110	376
4"	5	5	6	7	8	8	8	9	8	8	8	8	7	6	5	5	4"	111	380
4"	5	5	6	7	8	8	8	9	9	8	8	8	7	6	5	5	4"	112	383
4"	5	5	6	7	8	8	9	9	9	8	8	8	7	6	5	5	4"	113	386
4"	5	5	6	7	8	8	9	9	9	9	8	8	7	6	5	5	4"	114	390
4"	5	5	6	7	8	9	9	9	9	9	8	8	7	6	5	5	4"	115	393
4"	5	5	6	7	8	9	9	9	9	9	9	8	7	6	5	5	4"	116	396
4"	5	5	6	7	9	9	9	9	9	9	9	8	7	6	5	5	4"	117	400
4"	5	5	6	7	9	9	9	9	9	9	9	9	7	6	5	5	4"	118	403
4"	5	5	6	7	9	9	9	10	9	9	9	9	7	6	5	5	4"	119	406
4"	5	5	6	7	9	9	9	10	10	9	9	9	7	6	5	5	4"	120	409
4"	5	5	6	7	9	9	10	10	10	9	9	9	7	6	5	5	4"	121	413
4"	5	5	6	7	9	9	10	10	10	10	9	9	7	6	5	5	4"	122	416
4"	5	5	6	7	9	10	10	10	10	10	9	9	7	6	5	5	4"	123	419
4"	5	5	6	7	9	10	10	10	10	10	10	9	7	6	5	5	4"	124	422