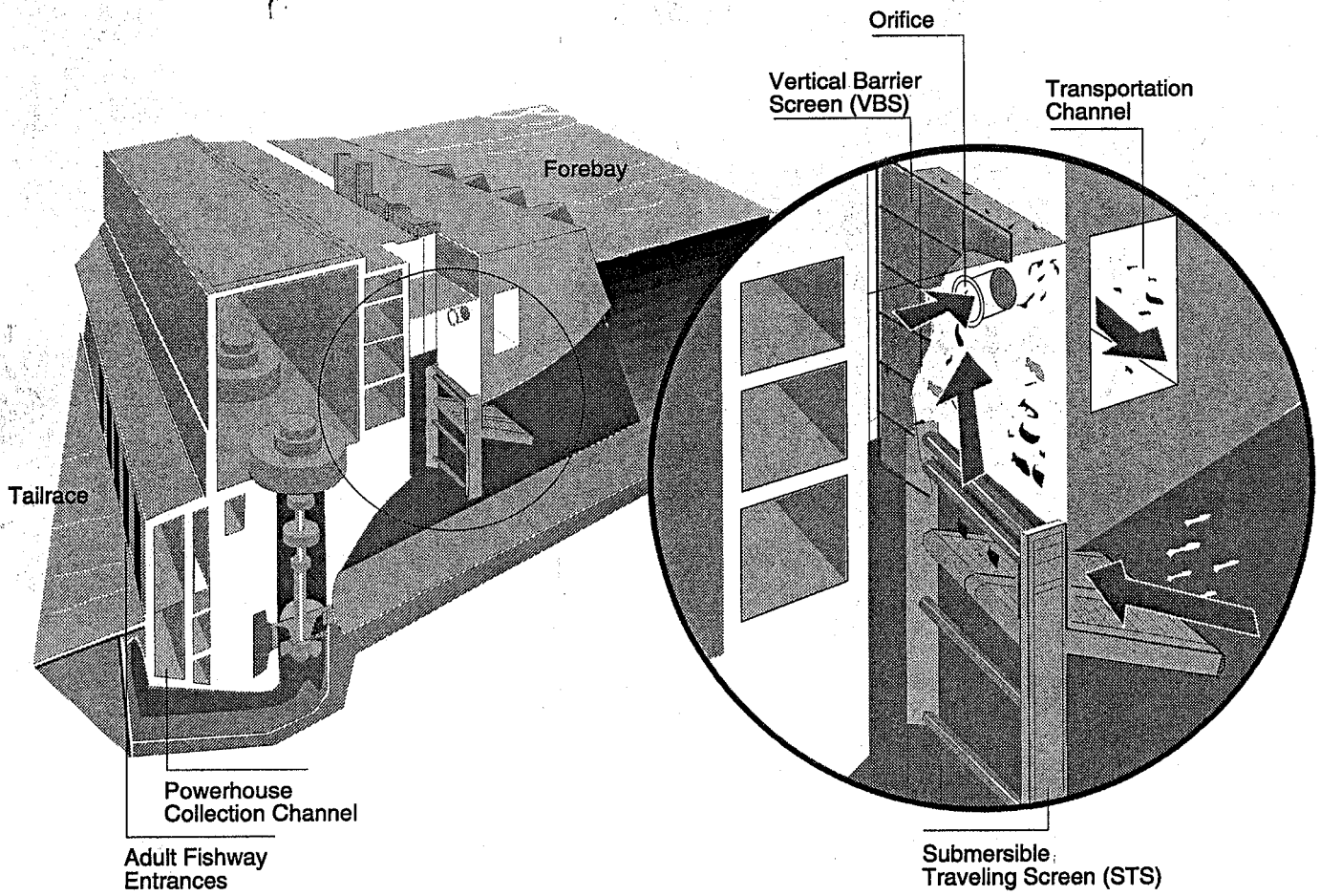
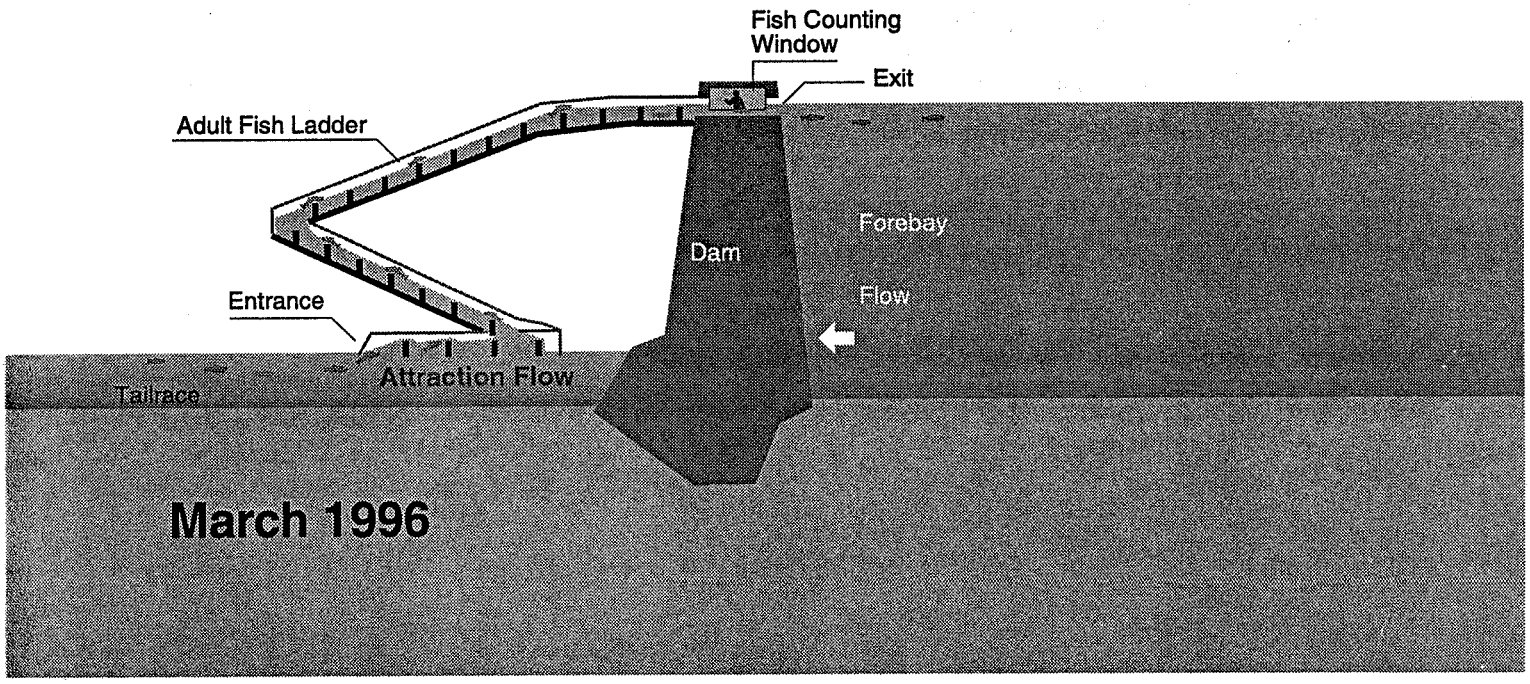
US Army Corps of Engineers

North Pacific Division

Fish Passage Plan
Corps of Engineers Projects

CENPD-ET-PR





March 1996

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FISH PASSAGE PLAN

1. General. The Corps' Fish Passage Plan (FPP) is developed in coordination with the region's fisheries agencies, Indian tribes, the Bonneville Power Administration (BPA), and other participants through the Corps' Fish Passage O&M Coordination Team. It is revised as necessary to incorporate changes to project operations and maintenance as a result of new facilities or changes in operational procedures.

FPP revisions will incorporate changes adopted through coordination with the National Marine Fisheries Service (NMFS) as part of the Endangered Species Act (ESA) Section 7 consultation, Recovery Plan, or Section 10 permit processes, and through consideration of other regional input and plans. The current revisions reflect provisions contained in the NMFS' Biological Opinion issued 2 March 1995 (Reinitiation of Consultation on 1994 - 1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years) and in the Corps' Record of Decision signed 10 March 1995 (U.S. Army Corps of Engineers North Pacific Division Record of Decision, Reservoir Regulation and Project Operations, 1995 and Future Years).

FPP revisions are provided to the Northwest Power Planning Council (NPPC) for use by the Fish Operations Executive Committee (FOEC) as part of the overall river operation plan. When revising the FPP, the Corps considers the amended NPPC Columbia River Basin Fish and Wildlife Program to the fullest extent practicable.

The FPP describes year-round project operations necessary to protect and enhance ESA-listed salmon species as well as other anadromous fish species. The FPP guides Corps actions in regard to providing fish protection and passage at the Corps' eight mainstem Columbia and Snake River projects. Other Corps documents and agreements related to fish passage at these projects are consistent with the FPP.

River operations emergencies may occur which require projects to deviate temporarily from the FPP. To the extent possible, these operations will be conducted to minimize fish impacts and coordinated with fisheries agencies and tribes.

Decisions on river operations to achieve interim fish passage efficiency (FPE) or survival goals for spring and summer outmigrants will be made in coordination with the Technical Management Team (TMT). FPE goals will apply until either project or system survival goals are developed. The Corps considers the following factors in implementing FPE and survival goals:

1. Spill provisions contained in the NMFS Biological Opinion on hydrosystem operations (Appendix F) and the Corps' Juvenile Fish Transportation Plan (JFTP) (Appendix C), which are implemented where they apply;

2. Endangered, threatened, or depleted natural and wild stocks, which take priority for protection over hatchery stocks;

3. Potential for adverse impacts on other project uses; and,

4. Risk of adverse environmental and physical impacts.

Corps mainstem projects will provide spill for juvenile fish passage according to the NMFS Biological Opinion (specifications in Appendix F) to protect ESA-listed salmon species. These spill levels were developed through consultation with NMFS and may be changed during the fish migration season as recommended by the TMT. Continuous spill is provided at Bonneville, The Dalles, and Ice Harbor Dams for spring and summer outmigrants to meet Biological Opinion requirements. Nightly spill is also provided at John Day and McNary Dams (spring season only at McNary), and may be provided in the spring at the Snake River collector dams, Lower Monumental, Little Goose, and Lower Granite, under certain conditions of higher flow (see Appendix F). Spill also may be provided under special circumstances for nonlisted fish species, if recommended by the fisheries agencies and tribes and if the recommendations are consistent with regional operational agreements (i.e., Spring Creek Hatchery release).

Total dissolved gas (TDG) saturation levels are monitored at the forebay and tailrace of each mainstem project during the fish passage season. The water quality standard and criterion developed by the states and EPA is 110% of saturation at ambient temperature and pressure. Adherence to this standard is a goal of spill management by the Corps. However, the NMFS Biological Opinion calls for fish spill to be provided up until higher TDG levels are exceeded (Appendix F). Also, implementation of fish spill requests in the past has resulted in TDG levels of 120% or greater. Therefore, fish spill implementation will be subject to further coordination with appropriate entities if excessive TDG levels occur or if evidence of

gas bubble disease is observed in fish. Any spill requests that will cause exceedence of the state TDG standard must include appropriate coordination with state water quality agencies, including waivers of state water quality standards if necessary, previously obtained by the requester (see Appendix G, the Division Engineer's spill policy letter).

BPA guidelines on system load shaping to consider fish impacts are included in Appendix D. The guidelines describe procedures BPA follows to make hydropower load requests that enable the Corps to operate turbine units within 1% of peak efficiency.

Comments on the FPP are welcome. They may be directed either to the Fish Passage O&M Coordination Team or the Corps' North Pacific Division, Environmental Resources office in Portland, Oregon.

2. **Project Operation and Maintenance**. Appendix A contains the detailed criteria for operation and maintenance of fish passage facilities and project operation procedures for fish passage at the Corps projects on the lower Snake and lower Columbia Rivers. Unresolved differences between FPP criteria and prior recommendations of the fisheries agencies and tribes are highlighted within Appendix A.

3. **Juvenile Fish Transportation Plan**. Juvenile fish will be transported in accordance with the plan laid out in the NMFS Biological Opinion. Transportation criteria are contained in the JFTP, Appendix C. The JFTP covers the collection, holding, and transport of juvenile fish. Other project criteria on the operation of the

juvenile fish bypass systems are contained in Appendix A. Additional criteria may be developed as part of the NMFS ESA Section 10 permit process.

4. **Project Fish Passage Facilities Inspection and Reporting Criteria.**

a. **General.** Appendix A contains the detailed criteria for inspection and reporting criteria for fish passage facilities at the Corps projects on the lower Snake and lower Columbia Rivers. The Corps provides weekly written inspection reports to NMFS Environmental and Technical Division describing any out-of-criteria situations, adjustments made to resolve problems, and a detailed account of how out-of-criteria situations affected project fish passage and survival. The weekly inspection reports also include summaries of equipment calibrations, adult fish collection channel velocity monitoring, and water temperature monitoring. Equipment which does not require calibrating will not routinely be included in the weekly report. The Corps also provides an annual report to NMFS which summarizes project operations and maintenance and fish passage facilities inspections and monitoring.

b. **Criteria for Reporting Excursions Outside the 1% Peak Turbine Efficiency Operating Range.** Reporting excursions outside the 1% peak turbine efficiency operating range will be performed by BPA on a semi-monthly basis with a monthly synopsis. These reports will record instances where lower Columbia (LCOL) and lower Snake river (LSN) turbines were operated outside 1% peak efficiency ranges for significant periods as defined under the guidelines in Appendix D. BPA will prepare the reports by consolidating data provided by Corps project operators at LCOL and LSN projects. Reports will be sent to NMFS by BPA. The intent of excursion reporting is to provide a means for quality assurance during the fish

passage season when projects operate within the 1% peak turbine efficiency guidelines, as specified in Appendix D.

5. **Project Operation Criteria**. The following paragraphs summarize, by project, the operating criteria of the FPP. Special project operations, including spill, current research project summaries, and Project Improvements for Endangered Species (PIES) items are described in Appendix B. Operating schedules are provided in Appendix A and Appendix B, where applicable. Schedules may be adjusted for endangered species during certain conditions such as extended periods of additional flows, or to meet special fish needs.

a. **Bonneville Dam.**

The ten main generation units at the first powerhouse are screened. A small generation unit at the south end of the first powerhouse is not screened. The eight main generation units at the second powerhouse are screened. Two small generation units at the second powerhouse are not screened. Both powerhouses at Bonneville Dam have juvenile fish bypass systems.

(1) **Operation for Juvenile Passage**.

- Operate juvenile fish passage facilities in accordance with project operating criteria contained in Appendices A and B.

- Provide spill according to guidelines contained in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate the project throughout the year in accordance with project operating criteria as specified in Appendices A and B.

b. **The Dalles Dam**.

Turbine generation units at The Dalles are not screened. Approximately 3,600 to 4,000 cfs flow is routed through the ice and trash sluiceway during the juvenile passage season. This is an interim operation until a new juvenile bypass system becomes operational.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with project operation criteria contained in Appendices A and B.

• Provide spill according to guidelines contained in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate the project throughout the year in accordance with project operating criteria as specified in Appendices A and B.

c. **John Day Dam**.

All sixteen generation units are screened and the project has bypass facilities.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish passage facilities in accordance with operating criteria in Appendices A and B.

• Provide spill according to guidelines contained in Appendices B and F.

(2) **Operation for Adult Passage**.

• Operate the project throughout the year in accordance with operating criteria as specified in Appendices A and B.

d. **McNary Dam**.

All fourteen main generation units at McNary are screened. Two small station service units are not screened. Extended-length screens are being installed in 1996. The project has facilities to separate juveniles by size, then bypass them either directly to the tailrace or to raceways for transport by barge or truck to in-river release sites below Bonneville Dam. The collection and transportation facilities will operate during the summer/fall outmigration season.

(1) **Operation for Juvenile Passage**.

• Operate juvenile fish bypass and collection facilities in accordance with operating criteria in appendices A and B and the JFTP located in Appendix C.

APPENDIX A

OPERATION AND MAINTENANCE CRITERIA FOR FISH PASSAGE FACILITIES AT CORPS OF ENGINEERS PROJECTS

Bonneville Dam

I. BONNEVILLE DAM

A. Fish Passage Information. The locations of fish passage facilities are shown on the following general site plans for Bonneville Lock and Dam (p. BON-2 through BON-4).

1. Juvenile Fish Passage

a. Facilities Description

(1) First Powerhouse

(a) Facilities Description. 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 "O") is located at the south end of the powerhouse and is not equipped with screens. It is used for back-up station service and does not currently operate often.

There are also small channels associated with the auxilliary 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 & trash sluiceway at the south end of the powerhouse. These facilities are no longer operated on a regular basis.

(2) Second Powerhouse

(a) Facilities Description. Juvenile fish passage facilities at the Bonneville second powerhouse comprise turbine intake extensions (TIEs), streamlined trash racks, STSs (recently lowered for more effectiveness), VBSs, two 12" orifices per gatewell (with only one operating per gatewell) flowing into a fish bypass channel, an excess water elimination facility, and a 36" fish transport pipe which connects the bypass channel to the tailrace. 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.

b. Juvenile Migration Timing. Maintenance of juvenile fish facilities is scheduled for the period of approximately 1 December through February to reduce the impact on downstream migrants. Maintenance activities will be coordinated to minimize potential impacts on juvenile migrants that may be present during this time period.

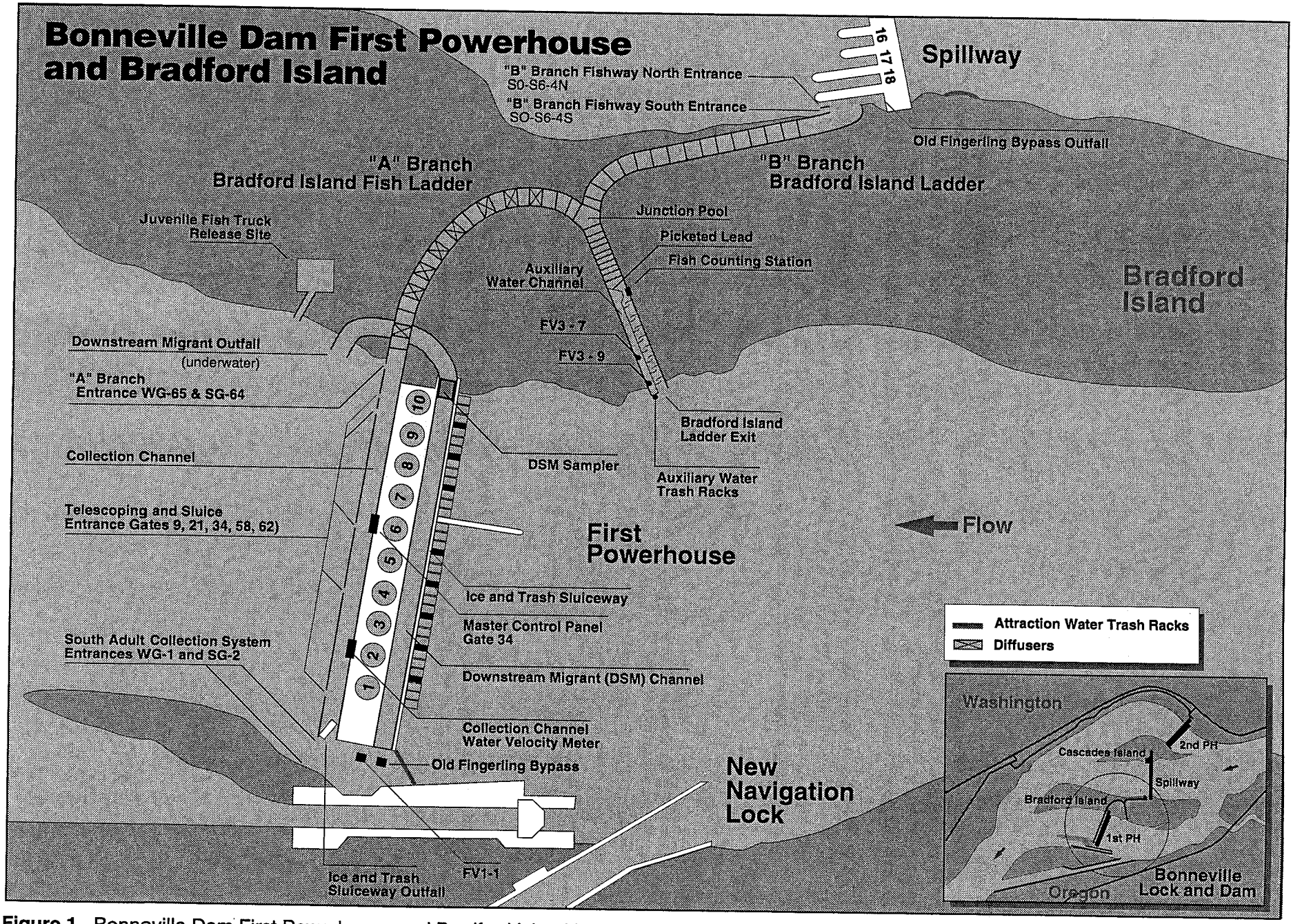

Figure 1 Bonneville Dam First Powerhouse and Bradford Island Fish Ladder

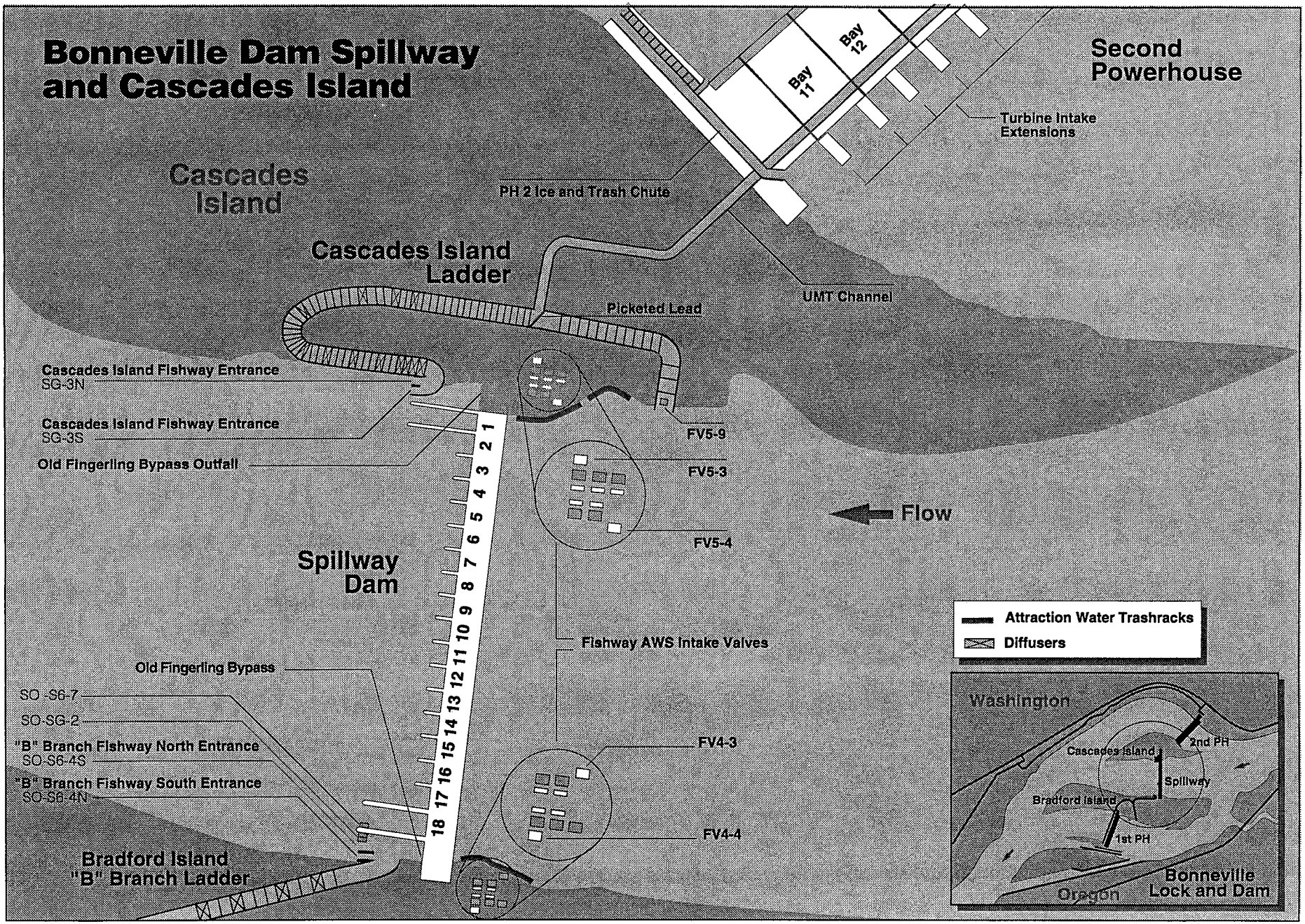

Figure 2 Bonneville Dam Spillway, Cascades Island Fish Ladder and Upstream Migrant Transportation Channel (UMT)

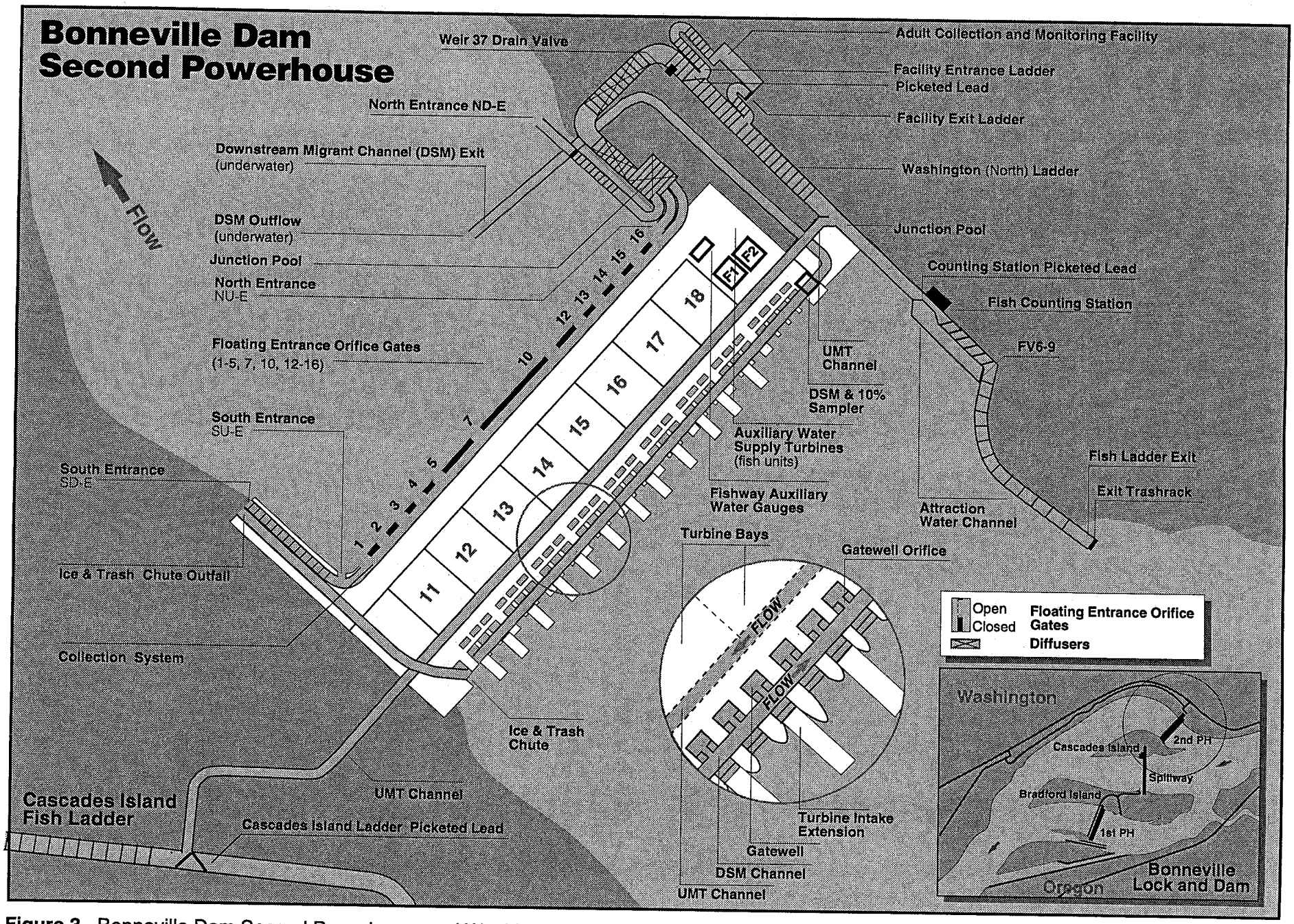

Figure 3 Bonneville Dam Second Powerhouse and Washington (North) Fish Ladder.

Table I. Bonneville Dam Juvenile Migration Timing, 1989 - 1995.

% PAST PROJECT[a]	YEAR/DATE						
	1989	1990	1991	1992	1993	1994	1995
Yrlg. Chinook							
10%	4/21	4/16	4/22	4/16	4/22	4/19	4/18
90%	5/21	5/22	5/31	5/15	5/28	5/31	5/26
Subyrlg. Chinook[b]							
10%	6/6	6/7	3/24	4/19	N/A	6/9	6/5
90%	7/29	7/12	7/23	7/8	N/A	7/26	7/15
Steelhead							
10%	4/22	5/1	5/9	4/25	5/10[c]	5/3[c]	5/4[c]
90%	5/29	6/4	5/31	5/29	5/26[c]	6/4[c]	5/29[c]
Coho							
10%	4/21	4/23	5/3	4/25	5/5	5/9	4/28
90%	5/29	6/9	6/1	6/3	5/25	6/5	5/29
Sockeye							
10%	5/10	5/8	5/19	5/11	5/17	5/13	5/10
90%	6/4	6/5	5/31	5/31	5/27	6/2	5/27

[a] Measured at the first powerhouse bypass trap.

[b] 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 percent of the subyearling chinook run which occurs after this June 1.

[c] Dates are for hatchery steelhead. Wild steelhead averaged a few days earlier for the 10% passage, and nearly the same for 90% passage.

c. **Facility Monitoring and Reporting.** Project biologists shall inspect fish passage facilities at the frequencies listed in the juvenile and adult fish facilities operating criteria sections. 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; 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 shall be sent to CENPP-CO as soon as possible the following week. The project biologist shall prepare an annual report by 31 January, summarizing the operation of the project fish passage facilities for the previous year. The report will cover from the beginning of an adult fish facility winter maintenance period to the beginning of the next.

2. Adult Fish Passage

a. **Facilities Description.** Adult fish passage facilities at Bonneville Dam are composed 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 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.

b. **Adult Migration Timing.** Upstream migrants are present at the project throughout the year. Adult passage facilities are operated year round. However, passage through the winter months is relatively light, and fish counting consists of video-taping with no visual counting from 1 November through 31 March, primarily to account for winter steelhead passage. The fish counting schedule appears in appendix B. Annual winter maintenance of adult fish facilities is scheduled from 1 December through February (In-water work period) to minimize the impact on upstream migrants, and to minimize adult fall chinook and steelhead fallback.

Adult migration count data for Bonneville Dam have been collected since 1938. Table II summarizes adult fish passage timing through 1993. 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 II. Bonneville Dam Adult Migration Timing, 1938 - 1993.

Species	Passage Period	Earliest Peak	Latest Peak
Spring Chinook	3/14 - 5/31	4/15	5/27
Summer Chinook	6/1 - 7/31	6/5	8/15
Fall Chinook	8/1 - 11/15	9/1	9/17
Steelhead	3/15 - 11/15	7/16	9/12
Coho	7/ - 11/15	8/29	9/20
Sockeye	5/ - 8/	6/22	7/13

B. Project Operation

1. General

a. Low FGE at the second powerhouse has been improved by implementation of three measures: 1) full installation of turbine intake extensions (TIEs) in front of alternate intake slots; 2) replacing the top three standard trash racks in each intake slot with streamlined trash racks; and 3) lowering the STSs. These improvements were first fully installed at the beginning of the 1993 fish passage season. Guidance for spring and summer general flow distribution between powerhouses and spill is provided in the main text of the Fish Passage Plan and in appendix B.

b. Summer operation: 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 will change (see description in the main text of this plan and in appendix B).

c. Research, non-routine maintenance, and other fishery related activities will not be conducted within 100' of any fishway entrance or exit, or directly in, above, of adjacent to any fishway, unless concurred with by regional fisheries managers through ESA and other fish passage issues. Alternate actions will be considered by district and project biologists in conjunction with the fishery 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.

2. Spill Management

a. General.

(1) Regardless of time of day, only one spill schedule will be used at Bonneville Dam (See Spill Schedule, p. BON-8 through BON-10).

(2) Nighttime spill is limited as necessary to control gas supersaturation. Adjustments of the nighttime spill level may be granted on a case-by-case basis by the Reservoir Control Center, dependent upon dissolved gas saturation readings at stations downstream of the dam, and upon fish movement. The hours of nighttime spill are the daily complements of the periods of daytime spill (see I.B.2.c. (1), below). However, changing spill gate positions takes some time, particularly for the gates which can't yet be operated remotely. So, the transition to the daytime cap should begin early enough in the day to minimize violating the defined daytime spill maximum and should not start until after the daytime cap period is over.

b. Juvenile Fish.

(1) Spill will be provided according to guidance described in appendices B and F.

(2) 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 under Operating Standards for Adult Passage Facilities.

c. Adult Fish.

(1) During the adult fish passage period, 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. However, during the sockeye passage season, 1 June through 15 August, the cap will apply until one hour after sunset.

SPILL SCHEDULE FOR BONNEVILLE DAM

updated 8 June 1993

BAY NUMBER																		DOGS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	1																4"	1	
4"	1															1	4"	2	
4"	1	1														1	4"	3	
4"	1	1													1	1	4"	4	
4"	1	1	1												1	1	4"	5	
4"	1	1	1											1	1	1	4"	6	
4"	1	1	1	1										1	1	1	4"	7	
4"	1	1	1	1									1	1	1	1	4"	8	
4"	1	2	1	1									1	1	1	1	4"	9	
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	53.8
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
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4"	4	3	3	2	2		2	2	2		2		2	2	3	4	4"	33	112
4"	4	3	3	2	2		2	2	2		2	1	2	2	3	4	4"	34	115

SPILL SCHEDULE FOR BONNEVILLE DAM

updated 8 June 1993

BAY NUMBER																		DOGS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	4	3	3	2	2		2	2	2		2	2	2	2	3	4	4"	35	119
4"	4	3	3	2	2	1	2	2	2		2	2	2	2	3	4	4"	36	122
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4"	7	6	5	4	3	3	3	3	3	3	3	3	3	4	5	6	4"	64	220
4"	7	6	5	4	3	3	3	3	3	3	3	3	4	4	5	6	4"	65	223
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	4	5	6	4"	66	227
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	4	6	6	4"	67	230
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	5	6	6	4"	68	234

SPILL SCHEDULE FOR BONNEVILLE DAM

updated 8 June 1993

BAY NUMBER																		DOGS	KCFS
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
4"	7	6	5	4	3	4	3	3	3	3	3	3	4	5	6	7	4"	69	237
4"	7	6	5	5	3	4	3	3	3	3	3	3	4	5	6	7	4"	70	240
4"	7	6	5	5	3	4	3	3	3	3	4	3	4	5	6	7	4"	71	244
4"	7	6	5	5	3	4	3	4	3	3	4	3	4	5	6	7	4"	72	247
4"	7	6	5	5	4	4	3	4	3	3	4	3	4	5	6	7	4"	73	251
4"	7	6	6	5	4	4	3	4	3	3	4	3	4	5	6	7	4"	74	254
4"	7	7	6	5	4	4	3	4	3	3	4	3	4	5	6	7	4"	75	258
4"	7	7	6	5	4	4	3	4	4	3	4	3	4	5	6	7	4"	76	261
4"	7	7	6	5	4	4	4	4	4	3	4	3	4	5	6	7	4"	77	265
4"	7	7	6	5	4	4	4	4	4	4	4	3	4	5	6	7	4"	78	268
4"	8	7	6	5	4	4	4	4	4	4	4	3	4	5	6	7	4"	79	272
4"	8	7	6	5	4	4	4	4	4	4	4	4	4	5	6	7	4"	80	275
4"	8	7	6	5	4	4	4	4	4	4	4	4	4	5	7	7	4"	81	279
4"	8	7	6	5	4	4	4	4	4	4	4	4	4	6	7	7	4"	82	282
4"	8	7	6	5	5	4	4	4	4	4	4	4	4	6	7	7	4"	83	285
4"	8	7	6	5	5	4	4	4	4	4	4	4	4	6	7	8	4"	84	289
4"	8	7	6	6	5	4	4	4	4	4	4	4	4	6	7	8	4"	85	292
4"	8	7	7	6	5	4	4	4	4	4	4	4	4	6	7	8	4"	86	296
4"	8	8	7	6	5	4	4	4	4	4	4	4	4	6	7	8	4"	87	299
																		0	

Gate settings, or "dogs", create the following openings.

1 = 1.0'; 2 = 2.9'; 3 = 4.9'; 4 = 6.8'; 5 = 8.7';
6 = 10.6'; 7 = 12.6'; 8 = 14.5'; 9 = 16.4'; 10 = 18.3';
11 = 20.2'; 12 = 22.1'; 13 = 24.1"; 14 = 26.0'

3. **Dissolved Gas Management and Control.** Implementation of spill requests will take into account dissolved gas monitoring data and the observed condition of migrant juveniles and adults, along with juvenile migration monitoring data. Total dissolved gas monitoring will be conducted by the Corps from a station in the Bonneville forebay and from several stations located below Bonneville Dam. Dissolved gas data will be reported every four hours starting prior to an early Spring Creek NFH fish release, but not later than 1 March for stations below Bonneville and on 1 April for the station at Bonneville and those further upriver. Collection will continue until Labor Day. Related data for Bonneville Dam reported at the same time will be spill volume and total project flow. The dissolved gas monitoring system is described in detail in appendix E.

Excessive Total Dissolved Gas 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.

4. **Juvenile Fish Passage Facilities**

a. First Powerhouse

(1) Operating Criteria

(a) Prior to the Juvenile Fish Passage Season:

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

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

iii) Inspect each STS and operate on trial run (dogged off at deck level). Install STS in each slot of operational turbine units by the end of the last work day in the work week closest to 1 March. However, see I.B.4.a.(1)(b), about accomodations when there is an early fish release from Spring Creek NFH.

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

v) Inspect and, where necessary, clean and/or repair dewatering screens and associated equipment.

vi) Inspect and correct any deficiencies of DSM channel and outfall conduit walls and floor.

vii) 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 operable by 1 March.

viii) Inspect and, where necessary, repair spill gates and control systems. Spillway, except for coordinated exceptions, must be able to achieve spill patterns on the first day of the juvenile fish passage system.

ix) The results of all inspections and the readiness of the facilities for operation will be verbally reported to the Fish Passage O&M Coordination Team at the meeting immediately prior to the juvenile fish passage season.

(b) Juvenile Fish Passage Season: The passage season begins on the date of a work week end which is closest to 1 March, and ends on the Monday which is closest to 30 November (see appendix B). Bonneville Project's current work week is Monday through Thursday. When possible, the first powerhouse juvenile fish protection devices (STSs, etc.) will be in place for an early fish release from Spring Creek NFH, if scheduled to occur before the juvenile fish passage season.

i) 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 feet of total drawdown in gatewell, as indicated by fish condition (e.g., higher than expected descaling), or as determined by the project biologist. STSs in units being raked will be run in continuous mode during raking operation. Gatewell orifices of the unit being raked must be closed during the procedure.

ii) Operate STSs at 55 degree angle from vertical.

iii) Inspect each STS once per month and each VBS a minimum of once every two months (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. Inspect STSs and VBSs within a timeframe to minimize damage to screens following the arrival of heavy debris at the dam. 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 1 May, mid-July, and 1 September. 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: 1) deterioration of fish conditions; 2) increased debris load in bypass system; and 3) other indications of STS or VBS malfunctions or failure. Records of inspections or summary of such records will be made available to the Fish Passage Center (FPC) by 1 January.

CBFWA recommends that VBS inspections be conducted once per month through the fish passage season.

iv) Operate all gatewell orifice systems. Inspect each daily to assure that the orifice valves and lights are operating correctly. Back-flush at least every day or more often if indicated by debris accumulations. Replace all burned out orifice lights within 24 hours.

v) In the DSM downwell area [1]:

a) Maintain between 0.9 and 1.3 feet of depth, 1.0 foot preferred, over the end of the DSM inclined dewatering screen.

b) Maintain differential between forebay and dewatering screen between 5.3 and 5.7 feet.

c) Maintain drop from dewatering screen to water surface in downwell between 3.0 and 4.5 feet.

[1] Standards listed are for normal operation. During smolt sampling, depth of water over the inclined screen and elevation of the water surface in the downwell are lowered.

d) Operate dewatering screen trash sweep one (1) revolution at 20 minute intervals. The interval between operations may be doubled when the amount of debris passing is light.

vi) Observe each STS amp gauge reading at least once each shift and record readings once per day. If an STS failure occurs, then follow procedures in the Fish Facilities Maintenance Plan (see p. BON-19).

vii) Inspect all STS gatewells daily. The project will clean before gatewell 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 fishery measures, and then only on a last on/first off basis. The first powerhouse gatewell orifices will be closed during the debarking operation. After debarking a gatewell, back-flush the orifice in that gatewell. Check gatewell drawdown.

viii) 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 (eg. oil slick) occur in gateslots, 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 consultation with FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

ix) Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

x) 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.

xi) Turbine units without full compliments of STSs will not operate, except to be in compliance with other coordinated fishery measures.

CBFWA recommends no operation of partially or fully unscreened turbines unless otherwise agreed.

xii) During the juvenile fish passage season, open sluice gate 7A to a depth of 3.5 feet and 10C to a depth of 2.5 feet below the daily expected forebay elevation 1 (see Endnotes, p. BON-29). The ice and trash sluiceway may be closed for a two month period beginning October 1, if it is determined, through Regional coordination, that migrating juvenile salmonid numbers are low enough that closure will not adversely affect fish migration or fish condition. This closure is subject to annual Regional evaluation, and may be terminated at any time if problems arise that negatively impact salmonid migration or fish condition. Whenever the old juvenile fish bypass located at the south end of the powerhouse operates, some flow must be maintained through the ice & trash sluiceway, since the bypass flows into the sluiceway. However, the old fingerling bypass is no longer operated as a juvenile fish passage system.

xiii) Inspect juvenile fish passage facilities twice per day, except where other guidance is provided elsewhere within this plan for specific facilities.

(c) Winter Maintenance Season. The winter maintenance season begins on the Monday which is closest to 30 November and ends on the last day of a work week closest to 1 March. However, the end of the season may be shortened for an early fish release from Spring Creek National Fish Hatchery.

i) All STSs removed.

ii) Once STSs are removed, DSM channel may be dewatered throughout most of this period if STSs must be stored beneath the intake deck, which places the STSs directly in front of the gatewell orifices (see Dewatering Plans, p. BON-27).

b. Second Powerhouse

(1) Operating Criteria

(a) Prior to the Juvenile Fish Passage Season.

i) Remove debris from forebay, trashracks, and gatewell slots such that these areas are free of debris.

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

iii) Inspect each STS and operate on trial run (dogged off at deck level).

iv) Install STS in each intake of operational units. Second powerhouse STSs are to be installed by the date of a work week end which is closest to 1 March. When possible, however, the 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 the juvenile fish passage season.

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

vi) Inspect and, where necessary, clean and/or repair dewatering screens and associated equipment.

vii) Inspect and correct any deficiencies of DSM channel and conduit outfall walls and floor.

viii) 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 operable by 1 March.

(b) Juvenile Fish Passage Season. The juvenile fish passage season begins on the date of a work week end which is closest to 1 March, and ends on the Monday which is closest to 30 November (see appendix B). Bonneville Project's work week is Monday through Thursday. Juvenile fish protection devices (STSs) are to remain in operation until 15 December to protect adult fallbacks.

i) Main unit gatewell drawdown will be measured a minimum of once per week. Remove debris from forebay and trash racks as required to maintain less than 1.5 feet of drawdown in gatewell or as indicated by fish condition (eg., higher than expected descaling) or as determined by the project biologist. STSs in units being raked will be run in continuous operating mode during raking operation. Gatewell orifices of the unit being raked must be closed during the procedure.

ii) Measure fish unit gatewell drawdown at least once per week. Remove debris as described above for main units, when necessary. However, to reduce the number of times the fish units have to be shut down during the daytime adult fish passage period, the fish units may be shut down between 2400 and 0300 hours as required to control drawdown. Also, main unit 18 may be operated during this time period, even at times when it otherwise would not be high enough on the priority list, to help draw debris away from the fish unit trash racks when the fish units are shut down.

iii) Operate STSs at angle of 60 degrees from vertical.

iv) Inspect each STS once per month and each VBS a minimum of once every two months (video is acceptable). Frequency of monthly inspections may be based on individual turbine unit run time. 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 1 May, mid-July, and 1 September. 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: 1) deterioration of fish conditions; 2) increased debris load in bypass system; and 3) other indications of STS or VBS malfunctions or failure. Prior to pulling VBSs for inspections, shut off units and dip gatewells.

CBFWA recommends that VBS inspections be conducted once per month through the fish passage season.

If STS or VBS damage or plugging is detected, follow procedures in Fish Facilities Manitenance Plan. Records of inspections or summary of such records will be made available to the FPC by 1 January upon request.

v) Operate all gatewell orifice systems. Inspect each daily to assure that the orifice valves and lights are operating correctly. Orifices with less than a clear flow jet will be cleaned at least once per day. Replace all burned out orifice lights within 24 hours. Electrical modifications were made in 1995 which allow central, automatic lighting control in the PH2-DSM. The DSM is now darkened on a scheduled as determined through coordination with the Corps' Fish Passage O&M Coordination Team in 1994. The PH2-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.

vi) Inspect each STS amp gauge at least once each shift and record reading once per day. If an STS failure occurs, then follow procedures in Fish Facilities Maintenance Plan (p. BON-19).

vii) Inspect all STS gatewells daily. The project will clean before gatewell 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 fishery measures, and then only on a last on/first off basis. After debarking a gatewell, inspect and if necessary, clean the orifice in that gatewell. Check gatewell drawdown.

CBFWA recommends the gatewells be cleaned before they become half covered.

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIEs) program. A gatewell orifice sluice to remove debris and reduce fish handling is being developed for implementation in 1996.

viii) 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 consultation with FPC and NMFS. Regardless of unit operating status, oil accumulations will be dealt with promptly.

ix) Coordinate gatewell cleaning with personnel operating downstream migrant sampling facilities.

x) 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.

xi) Turbine units without full compliments of STSs may not operate except to be in compliance with other coordinated fishery measures.

CBFWA recommends no operation of partially or fully unscreened turbines unless otherwise agreed.

xii) Maintain DSM water surface between elevations 64.7 - 65.2 as measured at the south end of the channel.

xiii) Maintain water surface on dewatering screen between elevations 60.8 - 61.2.

xiv) Maintain water surface in downwell as close as possible to 57.5' +/- 0.5' under the automatic control system.

xv) Inspect facilities twice per day.

xvi) Operation of the Emergency Relief Gate (ERG) may strand juvenile fish that are near the dewatering screen when the water recedes. Training and maintenance operation of the ERG during the juvenile fish passage season should be minimized. As much as practical, all operation of the ERG should be coordinated through the project biologist. To ensure that the ERG is operable when needed, operation should be tested at the beginning of the juvenile fish passage season and once mid-season. Tests will be done at such a time as to create the least impact to migrating fish.

(c) **Winter Maintenance Season.** The winter maintenance season begins on the Monday closest to November 30 and ends on the last work day of a work week closest to 1 March. However, the end of the season may be shortened for an early fish release from Spring Creek National Fish Hatchery.

i) To reduce adult fallback mortality, the juvenile bypass system, or DSM channel will operate from 30 November to 15 December. STSs from priority units will be left in place during this period to the extent practicable. Screens from non-priority units may be removed beginning 27 November, but only if scheduled for maintenance. In all units, screens that are not being serviced shall be left in place during this period. Following 15 December, all remaining STSs may be removed. DSM may be dewatered (see Dewatering Plans) only when required for maintenance. The period of maintenance 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.

ii) Turbine intake extensions (TIEs) will be removed following the spring juvenile yearling chinook outmigration period, usually in early July. TIEs will be re-installed just prior to the start of the juvenile fish passage season, including, when practicable, prior to early hatchery releases from Spring Creek National Fish Hatchery.

5. Adult Fish Passage Facilities

a. Operating Criteria

(1) Prior to 1 March

(a) Inspect 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.

(2) 1 March through 30 November. (Adult Fish Passage Period)

(a) All Adult Facilities

i) Water depth over fish ladder weirs: 1.0' +/- 0.1' during the non-shad passage season (1 August through 14 May).

ii) Measure water temperature within each ladder system and in associated forebay and tailwater locations daily to reveal if temperature variances exist between locations. Additional monitoring equipment will be installed in 1996. Summaries of water temperature measurements will be included in weekly operation monitoring reports.

iii) Head on all entrances: 1.0 to 2.0 feet (1.5 feet preferred). A head of approximately 1.0 to 2.0 feet at the NUE entrance is indicated by a 1.2 to 2.2 foot (1.7 feet preferred) entrance head calculated using the fishway and tailwater staff gauges closest to NUE. Refer to maintenance plan when unable to achieve head criterion.

iv) A transportation velocity of 1.5 to 4.0 feet per second (2.0 fps preferred) shall be maintained for the full length of the powerhouse collection channel, the

lower ends of the fish ladders which are below the tailwater, and the Upstream Migrant Transportation (UMT) channel .

v) Maximum of 6" head will be allowed on the first powerhouse attraction water intakes and trashracks at all the ladder exits, with a 4" maximum head on all picket leads. Debris shall be removed when significant amounts accumulate.

vi) Staff gauges and water level indicators will be readable at all water levels encountered during the fish passage period. 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.

vii) 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. If counting is temporarily discontinued due to unscheduled events, or the fishway is dewatered, the crowder shall be fully opened, except during the counters' hourly ten minute break period. Leave fish passage slot lighted overnight.

viii) Inspect facilities twice per day.

ix) Upstream light banks in both count stations shall remain off in an attempt to facilitate fish passage through the count slot, and help reduce the number of fish impacting the count window framework.

x) Inspect and ensure that optimum passage conditions are maintained at fishway entrances and exits.

(b) Spillway Ladders

i) Spill bay gates 1 and 18 shall be open 4" to attract adult migrating fish to the adjacent fishway entrances, throughout the adult fish passage season.

ii) 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 feet, 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 feet, the south sluice gate shall close. When the tailwater exceeds 17 feet, sluice gates SW-SG-3N, SW-SG-3S, SO-SG-4N, and SO-SG-4S shall be closed.

(c) First Powerhouse

i) Entrance gate 65 structure and operation is being modified during February and March, 1996 under the PIES program. The gate should be operable soon after the start of the adult fish passage season. Operation guidelines were not available at time of printing of the 1996 FPP, but may be requested from the project or district biologists.

ii) Entrance gate 64 structure and operation is being modified during February and March, 1996 under the PIES program. The gate should be operable soon after the start of the adult fish passage season. Operation guidelines were not available at time of printing of the 1996 FPP, but may be requested from the project or district biologists.

iii) Operate powerhouse entrance gates 9, 21, 34, 58, and 62.

Orifice A (lower sluice gate) operates (opens) from tailwater elevation 7.0' to 16.0' on a rising tailwater and elevation 15.0' to 7.0' on a falling tailwater.

Orifice B (upper telescoping gate) operates (opens) from tailwater elevation 16.0' to 38.0' on a rising tailwater and elevation 38.0' to 15.0' on a falling tailwater.

iv) Powerhouse entrance gates 1 and 2 structure and operation is being modified during February and March, 1996 under the PIES program. The gates should be operable soon after the start of the adult fish passage season. Operation guidelines were not available at time of printing of the 1996 FPP, but may be requested from the project or district biologists.

(d) Second Powerhouse

i) Operate all north (NUE and NDE) and south (SUE and SDE) entrances. Operate weir crests at elevation 1.0' (fully lowered) for tailwater elevations up to 14.0'. For tailwater elevations greater than 14.0', operate weir crest 13.0' or greater below tailwater.

ii) Operate all 12 powerhouse floating gate fishway entrances.

(e) Spillway Operations

i) Bonneville Dam uses a single spill schedule for use both day and night (See **Spill Schedule For Bonneville Dam**, p. BON-8 through BON-10).

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

(1) 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. Adult facilities will be inspected once per day to assure operation as per standards above. 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. The units in the powerhouse with the fully operating fish facility will be first on/last off to meet power demand, except when the powerhouse 1 collection facility is out of service, units 1, 2 and 10 will continue to operate. One of the two ladders servicing the spill channel will be in full operation at all times unless specially coordinated. Outage periods will be minimized to the extent practicable.

(2) Spill bays 1 and 18 may be on seal throughout the winter operating period.

(3) Adjust crowders 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.

C. Fish Facilities Maintenance

1. General

a. Scheduled Maintenance

(1) Staff gauges will be installed, cleaned, and/or repaired as required.

(2) A zebra mussel monitoring program will continue. These organisms have become a serious problem elsewhere in the country and are expected to eventually become introduced to the Columbia.

(3) 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.

2. Juvenile Fish Passage Facilities

a. Scheduled Maintenance

(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.

(2) **Juvenile Bypass System.** The Bonneville juvenile bypass facilities will receive preventive maintenance at all times of 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 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 raking of trash racks may be necessary when a storm brings large quantities of debris downriver to the project. Gatewell orifices of the unit being raked will be closed during the procedure (applies only to the first powerhouse).

(3) **Turbines and Spillways.** The maintenance and routine repair of project turbines and spillways is a regular and recurring process which requires that units be shut down for up to two months (see Dewatering Plans). The maintenance schedules for these turbines and spillways will be coordinated with the fisheries agencies through the Corps' Fish Passage O&M Coordination Team. Certain turbine and spillway discharges at the projects are secondarily used to attract adult fish to the areas of fishway entrances, to keep predator fish from accumulation in the area of 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.

Some types of maintenance on turbines will result in the requirement to operate the turbine throughout its full capability before returning the turbine to normal service. These operations will be coordinated.

b. Unscheduled Maintenance

(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.

(2) Juvenile Bypass System

(a) Bonneville Project's juvenile bypass systems are controlled by automatic systems. 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 cleaned out.

(b) Inspect all STS gatewells daily. 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 fishery measures. This is to maintain clean orifices and minimize fish injury. The first powerhouse gatewell orifices will be closed during the debarking operation. After debarking a gatewell, back-flush the orifice in that gatewell. Check gatewell drawdown.

CBFWA recommends the gatewells be cleaned before they become half covered by debris.

The Corps is currently attempting to resolve this conflict through an element of the Project Improvements for Endangered Species (PIES) program. A gatewell orifice sluice to remove debris and reduce fish handling is being developed.

(c) Bonneville First Powerhouse. If any part of the dewatering screen, downwell, or juvenile release conduit fails, making this porton 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 downstream migrant (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 a depth of 3.5 feet[2] (see Endnotes, p. BON-29), gate 10C to 2.5 feet below the minimum expected forebay, and the ice and trash sluiceway end gate is open to provide safe transportation flows for juveniles. Forebay elevation will be kept above 74.0' 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 debarking.

(d) Bonneville Second Powerhouse. If the bypass system fails in the dewatering section, downwell, 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 consultation with CBFWA. During this emergency operating mode, power generation will be minimized at the second powerhouse. Repairs will receive high priority.

(e) During fishway inspection the VBSs may be found to be plugged or damaged. In these cases, the associated unit will be regarded as if unscreened and repairs will be made before returning the unit to normal service.

3. **Turbines and Spillways**

a. **Spill gate failure.** If a spill gate becomes inoperable, the operator will 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 Fish Passage O&M Coordination Team.

4. **Adult Fish Passage Facilities**

a. **Scheduled Maintenance**

(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.

(2) **Powerhouse and Spillway Adult Fish Collection Systems.** Preventive maintenance and repair occurs throughout the year. During the 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 diffision 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 (diver or video is acceptable) during the fish passage season, unless a channel must be dewatered for fishway modifications or to correct observed problems (see Dewatering Plans, pg. BON-27). Inspection by 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 unless specially coordinated. Any non-routine maintenance and fishway modifications will be handled on a case by case basis.

The project biologist or alternate Corps fisheries personnel will attend all dewatering activities potentially involving fish, as well as inspections, to provide fishery input (see Dewatering Plans).

(3) **Adult Fish Ladders and Counting Stations.** The adult fish ladders will be dewatered (see Dewatering Plans) 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 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 when necessary, and when practicable, during the time of day when fish passage is least affected.

b. **Unscheduled Maintenance**

(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 operation according to standards. This will allow the fish facility to operate according to 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.

(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 proceed north.

If closing the orifice gate fails to achieve a minimum fishway head of 1.0 feet when tailwater is greater than 17.0 feet, then operation of newly modified gate 1 and gate 65 weirs becomes necessary. Operational guidelines of these gates will be available upon request from the project or district fishery biologists.

When tailwater elevation is less than 17.0 feet and the gate 65 weir crest is at least 6.0 feet below tailwater, then operation of newly modified gates 1, 2, 64, and 65 becomes necessary. Operational guidelines of these gates will be available upon request from the project or district fishery biologists.

(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 1.0 foot 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 6.0 feet below the tailwater surface is reached. At this point maintain the gate positions until the auxiliary water system is repaired.

(c) **Second Powerhouse.** If either or both of the fishway auxiliary water turbines are unable to provide water sufficient to meet full criteria between 1 April and 31 August, raise the North Upstream Entrance (NUE) in 1.0 foot increments until the weir crest is 6.0 feet below the tailwater or a fishway head of at least 1.0 foot is achieved. If this fails to achieve the above criteria then apply the same procedure, until the criteria are achieved, using in addition the North Downstream Entrance (NDE), then the South Upstream Entrance (SUE), and finally the South Downstream Entrance (SDE). The weir crests for these entrances will not be raised above 6.0 feet below tailwater. If the correct fishway head is still not achieved after this procedure, then fully close NUE and operate in this configuration until repairs can be made to the system.

If one of the fishway water supply turbine units fails between 1 September and 31 March, 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. Care will be taken to keep the trash chute screen free of debris and the downstream end gate will be raised briefly at least once weekly to flush trapped fish and debris out of the chute.

If both of the fishway auxiliary water turbines fail between 1 September and 31 March, and repairs can't be made within 8 hours, then the ice and trash chute will be started up. The adult facility will be operated as follows:

1: Close NDE, SUE, and NUE;

2: Operate the SDE weir crest at 8.0 feet below tailwater;

3: Operate the floating orifice gates. However, if the backup fishway auxiliary water system must be used for a period exceeding 30 days, then block off as many of the center floating orifice gates as possible and open NDE with a weir depth of 8.0 feet below the tailwater surface. While under this configuration, power generation at the second powerhouse will be minimized to reduce fish attraction into this area.

If all auxiliary water systems fail or malfunction, then close SUE, NDE, and NUE and raise SDE weir crest to 6.0 feet below tailwater elevation 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.

(2) Powerhouse and Spillway Adult Fish Collection Systems. Bonneville Project contains several types of fishway entrances. In most cases, if a failure occurs 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 the entrance will be brought back into manual or automatic control at the earliest possible date.

(3) Adult Fish Ladders and Counting Stations. The Bonneville first powerhouse ladder was completed in 1937 and the Bonneville second powerhouse ladder in 1981. Modification of the first powerhouse ladder was completed during the winter of 1981-82. The structures 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"), erosion of concrete 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 consultation with the Fish Passage O&M Coordination Team.

D. Turbine Unit Operation and Maintenance

1. Unit operating priority during the fish passage seasons.

Table IV. Bonneville Dam Fish Passage Season Unit Operating Priority.

1st POWERHOUSE		2nd POWERHOUSE
UNIT OPERATING PRIORITY	TIMES	UNIT OPERATING PRIORITY
1, 10, 9, 2, 3, (5-8), 4.	0500 - 2000	18, **11, 17,** 12, 16, 13, 14, 15.
	2000 - 0500	18, **17, 11,** 12, 16, 13, 14, 15.

- Flow distribution between powerhouses will be determined by CENPD-ET-WM.

- Unit 16 will follow unit 17 in priority if unit 18 is out of service.

- If unit 1 is out of service, replace it with unit 2 to maintain station service.

2. During the winter maintenance season, when powerhouse fish collection systems are operating, the operating priority sequence is unit 1, 10, 2, 18, and 11. Additional units will be selected in any sequence at the discretion of the powerhouse operators. Generally, when a unit in this list is not available, then an adjacent unit will be operated. When a fish collection channel is out of service the unit operating sequence will change accordingly, within the limitations of the project's power distribution requirements.

3. Guidelines for operation of the turbine units within 1% of peak efficiency and within cavitaiton limits at various head ranges are provided in **Bonneville Dam Peak Turbine Efficiency Ranges**[2] (p. BON-26).

4. To the extent technically feasible, turbines will be operated within +/-1% of peak turbine efficiency, unless operation outside of that range is necessary to: 1) meet load requirements of the BPA administrator, whose load requests will be consistent with BPA's System Load Shaping Guidelines; 2) avoid excess daytime spill (during the time of year when the 75 kcfs spill cap applies); or 3) comply with other coordinated fishery measures. BPA's System Load Shaping Guidelines (appedix D) apply between 15 March and 31 October. However, during the rest of the year the project will continue to operate units within the peak turbine efficiency range, except as specifically requested by BPA to do otherwise as power requirements demand.

CBFWA recommends operation of all units within 1% of peak turbine efficiency unless otherwise agreed.

(This comment applies to the following item, also.)

5. If it is necessary to operate outside the +/- 1% peak 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 peak efficiency range, they will be chosen according to the following proiritized list, where not constrained by specific project limitations. (5-8), 3, 9, 10, 2, 1, 15, 14, 13, 16, 12, 17, 11, 18.

6. The project's turbine unit maintenance schedules will be reviewed by Project and Operations Division biologists for fishery 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.

a. 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.

b. Unit 1 provides important attraction flow for adult fish, and when the juvenile bypass system flow is reversed, it helps move juvenile fish downstream also. 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.

c. In the event of long-term outages at Bonneville powerhouses, out of service (OOS) 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

[2] The guidance provided is based on an assumption of greater control and gauging accuracy than was originally possible. Elements of Passage Improvements for Endangered Species (PIES) program, completed in 1994, addressed achieving greater actual turbine efficiency.

BONNEVILLE DAM PEAK TURBINE EFFICIENCY RANGES

	FIRST POWERHOUSE				SECOND POWERHOUSE			
Head (ft)	Lower MW Limit	Lower Limit cfs	Upper MW Limit	Upper Limit cfs	Lower MW Limit	Lower Limit cfs	Upper MW Limit	Upper Limit cfs
34	14	6,116	26	11,258	29	12,047	39	16,478
35	14	6,114	27	11,278	29	12,055	40	16,578
36	15	6,112	28	11,297	30	12,063	41	16,578
37	16	6,158	29	11,328	31	12,070	43	16,627
38	16	6,205	30	11,360	32	12,078	44	16,677
39	17	6,251	31	11,391	33	12,086	45	16,727
40	17	6,318	32	11,422	34	12,044	47	16,777
41	18	6,371	33	11,464	35	12,022	49	16,826
42	19	6,424	34	11,506	36	11,960	51	16,876
43	19	6,476	35	11,547	37	11,918	53	16,926
44	20	6,529	36	11,589	38	11,881	55	17,008
45	21	6,582	37	11,631	39	11,844	56	17,090
46	22	6,646	38	11,646	39	11,807	58	17,173
47	22	6,711	39	11,661	40	11,770	59	17,255
48	23	6,775	40	11,677	41	11,733	61	17,337
49	24	6,839	41	11,692	42	11,747	63	17,338
50	25	6,904	41	11,707	43	11,760	65	17,338
51	25	6,968	42	11,722	44	11,774	66	17,339
52	26	7,030	43	117,379	45	11,787	68	17,339
53	27	7,091	44	11,752	46	11,801	70	17,340
54	28	7,153	45	11,768	47	11,842	72	17,340
55	29	7,214	46	11,783	48	11,884	73	17,341
56	29	7,276	46	11,798	49	11,925	75	17,342
57	30	7,337	47	11,813	51	11,967	76	17,342
58	31	7,399	48	11,828	52	12,008	77	17,343
59	32	7,427	49	11,844	53	12,050	77	17,343
60	32	7,455	50	11,859	54	12,091	77	17,344
61	33	7,482	51	11,874	55	12,103	77	16,967
62	33	7,510	52	11,889	56	12,115	77	16,590
63	34	7,538	53	11,904	57	12,128	77	16,214
64	34	7,566	54	11,919	58	12,140	77	15,837
65	35	7,593	55	11,935	59	12,152	77	15,460
66	36	7,621	56	11,950	60	12,164	77	15,083
67	36	7,649	58	11,965	61	12,176	77	14,706
68	37	7,677	58	11,951	62	12,189	77	14,330
69	38	7,704	59	11,937	63	12,201	77	13,953
70	39	7,732	59	11,923	64	12,213	77	13,576

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.

7. Until problems with the PH2 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. [3]

E. Dewatering Plans

1. Fish Salvage Plans 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 PH1 DSM is also included in the Fish Salvage Plans.

2. The project fish biologist or alternate Corps fisheries personnel will attend all project activities involving fish handling.

3. The fisheries agencies and tribes will be represented at all ladder dewaterings by the WDFW fish counting program supervisor or an alternate.

4. **Juvenile bypass systems.** Key elements of the fish salvage plan for JBS flow reversal are shown below.

a. With some exceptions, a project biologist or biological technician will attend all activities which involve dropping the JBS water surface below the end of the dewatering screen. One exception is when an operator with recent successful experience reverses PH1 JBS flow, as when required for research which requires flow through the outlet to be stopped and started repeatedly. Another similar exception is under the same circumstances at the PH2 JBS when the ERG gate is opened and closed.

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

c. The trash sweeps will be turned off of automatic control.

d. Flow through the dewatering screen will be minimized before the water level drops below the upper end of the screen.

e. 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. **Adult Fish Ladder**

a. Scheduled Maintenance

(1) When possible, operate the ladder to be dewatered at a reduced flow for at least 24 hours, but no more than 48 hours prior to dewatering. Reduced flow is defined as less than criterion operation, but more than orifice flow.

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[3] Memorandum for All Operations, from BON Chief of Operations, dated 23 September 1993. Subject: Powerhouse 2 Hydraulic Head Gate Operation.

(2) Discontinue all fishway auxiliary water supply at least 24 hours but no more that 48 hours prior to dewatering.

(3) The project biologist will assure that fish rescue equipment is available, and will coordinate to ensure adequate numbers of personnel will be available to move fish out of the dewatered ladder.

(4) Project personnel will install head gates to shut down ladder flow. Where possible, a minimum flow of 1-2 inches will be maintained in the ladder until fish are rescued.

(5) The project biologist or alternate Corps fisheries personnel will oversee fish rescue when the ladders are dewatered. The project biologist will invite fishery agency and/or Indian tribal biologists participation 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 depending on the fish' lifestage (adults to forebay, juveniles to tailrace) for release.

b. Unscheduled Maintenance

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

(2) Follow steps 3-5 above.

6. Powerhouse Fish Collection System

a. Scheduled Maintenance

(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.

(2) The project biologist will assure that rescue equipment is available if needed.

(3) The project biologist will provide technical guidance for fish safety and will assist directly as needed in rescue operations.

7. Turbines

a. 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.

b. When possible, place head gates and tail logs immediately after turbine unit is shut down if draft tube is to be dewatered.

c. Gatewells which will be drained when the turbine units are dewatered will have fish dipped out before draining.

d. 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.

e. 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.

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

g. The project biologist will invite Fish Passage O&M Coordination Team fishery biologists' participation in the dewatering, and will assure that rescue equipment is available if needed.

h. 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.

F. Endnotes

[1] Evaluation of Ice and Trash Sluiceway at Bonneville Dam as a Bypass System for Juvenile Salmonids, 1981. Calculated from hydraulic equation to achieve approximately 475 cfs (3.7 feet of head).

[2] Downstream Movements of Salmonids at Bonnneville Dam. Gauley, Anas, and Schlotherbeck, BCF, USFWS. Special Scientific Report, Fisheries No. 236 (January, 1958).

Bonneville Dam

BONNEVILLE DAM

1. **Spring Creek Hatchery Release.** Project operated to achieve 70 percent fish passage efficiency (FPE) during Spring Creek Hatchery Release which normally occurs in March. The latest subyearling chinook (before 6/15) fish guidance efficiency (FGE) data will be used to calculate FPE. The first powerhouse will operate as first priority during the hatchery release operation. The second powerhouse can be operated only after the first powerhouse has been fully loaded. If the second powerhouse is started, it must continue to be operated through the daylight hours.

2. **Special Project Operations.** Powerhouse priority during the spring juvenile salmon outmigration season and bypass screen operation during the summer juvenile salmon outmigration season are being reviewed in consultation with NMFS, and may be revised.

a. Spring Operations.

The first powerhouse will operate as first priority during the spring juvenile salmon outmigration season. The second powerhouse can be operated only after the first powerhouse has been fully loaded. If the second powerhouse is started it must continue to be operated through the daylight hours. Initial spring operations to achieve 70 percent FPE for lower river outmigrants, including spill, will begin after the first 10 percent of the spring migration has passed the project, but no later than 2000 hours 15 April. Spill to achieve 80 percent FPE, as requested in the NMFS Biological Opinion to protect endangered salmon species, will commence at 0001 hours on 20 April. All voluntary spill is subject to limitations to avoid producing excessive TDG levels downstream. Initially, the latest yearling chinook FGE (Table 1) will be used to calculate the project FPE. If migrating juvenile Snake River sockeye are detected in sufficient numbers in the lower Columbia River, changing to the latest sockeye FGE to calculate the project FPE will be considered.

b. Summer Operations.

The first powerhouse will operate as first priority during the summer juvenile salmon outmigration season. The second powerhouse can be operated only after the first powerhouse has been fully loaded. If the second powerhouse is started it must continue to be operated through the daylight hours. Operations to achieve 80 percent FPE for summer migrants will occur from 1 July through 31 August. The latest subyearling chinook (after 6/15) FGE data will be used to calculate project FPE.

c. Additional Special Project Operations.

The following priorities are in effect throughout the juvenile and adult fish passage season (end of the work week closest to March 1 through November 30). Maintain first powerhouse flows of at least 60 kcfs to provide favorable tailwater conditions for juvenile outmigration. If the second powerhouse is operating, also maintain flows of at least 60 kcfs. Both powerhouse can be reduced below 60 kcfs to minimum unit loading if needed to achieve the desired FPE and if necessary due to low river flows. The minimum loading in the first powerhouse is units 1, 2, 9, and 10. Units 9 and 10 are required to provide suitable flow to disperse juvenile fish from the JBS release site. Units 1 and 2 are necessary to provide energy to meet critical project loads including station service for the first powerhouse, navigation lock, fish hatchery, sewage treatment plant, project office buildings, well pumps, and an emergency first and second powerhouse interconnection. Normally, unit 1 is tied to the feeder bus and unit 2 remains on line, as a redundancy, in the event unit 1 fails. The minimum loading in the second powerhouse is units 11, 17 and 18. These units provide suitable flow conditions for migrating fish.

Any spill occurring during the daylight hours will not exceed 75,000 cfs or be reduced below 50,000 cfs, without special coordination and to the extent possible, depending on powerhouse limitations and special flow requirements. Nighttime spill to achieve 80 percent FPE will be limited as necessary to avoid producing excessive TDG downstream. The Corps' RCC will determine maximum nighttime spill to avoid producing excessive dissolved gas levels, and provide specific flow distribution guidelines to the project.

Table I. FGE values for the first and second powerhouses used to calculate FPE.

	Bonneville First	Bonneville Second
Chinook yearlings	37%	48%
Chinook subyearlings (before 6/15)	39%	50%
Chinook subyearlings (after 6/15)	10%	32%
Coho	63%	55%
Sockeye	23%	37%
Steelhead	56%	41%

3. Research.

a. Numerous evaluations will be conducted at the projects to document salmonid behavioral responses to particular hydraulic flow fields. This information will be used to evaluate specific structural modifications intended to improve passage conditions. Hydroacoustics, radio telemetry, sonic tags, and various acoustic methodologies will be used to survey, and in some cases (i.e. acoustic technologies) attempt to modify fish behaviors. Direct capture and mark and recapture studies will be used to evaluate fish condition and migration patterns, and hydraulic velocity mapping (ADCP) will document and verify forebay flow fields.

b. Special operations required to support these studies will be conducted outside of the juvenile fish migration period to the extent practicable. However, some modifications to standard project operations will be necessary to complete specific studies. These could include increasing or reducing spill and sluiceway volumes, adjusting powerhouse or turbine unit loads, and manipulating pool elevations.

c. At this time, study designs being developed for the Surface Bypass Program will include installing up to four baffled spillway structures at The Dalles dam. At least one spillway bay will be equipped with an 'I' configured baffle, and at least one additional bay will be equipped with an overflow weir. Studies will probably include modifying the spill pattern to incorporate use of these baffled structures on a random basis throughout the fish passage season. Overflow weirs may also be tested at Bonneville and John Day Dams in similar fashion.

d. The effects of lowering the zone of flow separation into a turbine unit will be tested at both Bonneville and The Dalles Dams. At Bonneville, two main units will have trashracks blocked down to an elevation of approximately 30' for two week testing blocks in the spring and summer. Sluicegates will be operated over the test units for the duration of these studies, as opposed to those gates currently required for normal operation (7A, 10C). The second powerhouse trash chute will also be operated periodically to sample fish passage effectiveness, and efficiency relative to the rest of the Bonneville project. Trashracks will be

randomly blocked at The Dalles Dam in front of as many as seven turbine units, including the two fishwater turbine units, for much of the fish passage season. Operation of The Dalles Dam sluiceway will only be effected while trashrack blocks are being manipulated.

e. Additional studies to be conducted at Portland District Columbia River Projects will include the Lower Columbia River Adult Salmon and Steelhead Passage Evaluation. Adult fish will be collected at the Bonneville Dam adult collection facility, tagged and released for tracking throughout the basin. Extended guidance screen research will occur at John Day Dam, requiring special operation of main units six and seven. FGE, OPE, and descaling evaluations will be included in this study, will require a fyke net in main unit seven, and daily gatewell sampling from the test units. Horizontal distribution may also be surveyed via periodic gatewell samples taken from additional units at the powerhouse.

f. All special operational requests will be coordinated through the Anadromous Fish Evaluation Program.

4. **Fish Counting Program.**

a. 1 January - 31 March: Video count 24 hours per day.

b. 1 April - 31 October: Visual count 16 hours per day (0400 - 2000 PST).

c. 1 April - 31 October: Video count 8 hours per day (2000 - 0400 PST).

d. 1 November - 31 December: Video count 24 hours per day.

5. **Project Improvements for Endangered Species.**

a. **Spill Pattern Modifications.** This item is to: 1) develop a new spill pattern for use at night for juvenile fish (completed in 1992); 2) develop a new spill pattern for use during the daytime for adult fish attraction (completed October 1993) and; 3) automate spill gates to enable closer adherence to prescribed spill patterns (scheduled to be completed by April 1996).

b. **STS, VBS & Orifice Inspection System.** This item is to provide a more efficient and reliable way to inspect the condition of JBS components during the passage season. Prototype system is scheduled to be completed by March 1995. Testing will be conducted on the unit at John Day Dam for one year prior to procurement of additional units for Bonneville and The Dalles dams.

c. **Gatewell Debris Removal System.** This item is to enable debris removal from gatewells with minimum impact on fish. Methodology is being developed at Bonneville Dam and will be tested in 1995.

d. **Modify Upstream Migrant Fishway Entrances.** This item is to modify entrances to the first powerhouse collection system to present better entrance conditions throughout the full range of tailwater elevation change. Scheduled to be completed by April 1996.

6. **Other.**

a. Additional temperature monitoring equipment will be installed, operated, and maintained in adult fishways, forebays, and tailraces as required by the NMFS Biological Opinion.

APPENDIX D

BPA's SYSTEM LOAD SHAPING GUIDELINES TO ENABLE OPERATING TURBINES AT PEAK EFFICIENCY

BONNEVILLE POWER ADMINISTRATION'S SYSTEM LOAD SHAPING GUIDELINES TO ENABLE OPERATING TURBINES AT PEAK EFFICIENCY

Background

Outmigrating juvenile salmonids have several potential routes of passage past hydroelectric dams on the mainstem Columbia and Snake Rivers, including turbines, mechanical bypass, sluiceways, and spillways. Fish passage survival varies depending on the route of passage. As a result of reported high mortality rates for fish passage through turbines (Long 1968; Schoeneman et al. 1961), regional efforts have been focused on providing non-turbine passage routes for juvenile fish as a means to reduce turbine-related mortality and improve fish survival. Nevertheless, substantial numbers of juvenile fish may continue to pass through turbines; therefore, effort to minimize turbine-related mortality is a priority of the fishery agencies and Indian Tribes, National Marine Fisheries Service (NMFS), U.S. Army Corps of Engineers (Corps), and Bonneville Power Administration (BPA).

Turbine operating efficiency has a relatively direct effect on fish passage survival; the relationship between survival of juvenile fish passing through Kaplan turbines is positively correlated and roughly linear to the efficiency at which the turbines are operated. Bell (1981) recommended making every effort to operate turbines at peak efficiency at a given head during periods of peak fish passage to minimize fish mortality.

A. Turbine Efficiency

For the purposes of this document, peak turbine efficiency operation shall be based on efficiency tables provided by the Corps for each project in the Fish Passage Plan (FPP). The Corps shall ensure that these efficiency ranges are based on the best available information, and that updates are coordinated with BPA, and the Fish Facility Operation and Maintenance Committee and operating agencies. The tables will be distributed to all operating agencies prior to implementation, allowing at least two working days after receipt of the tables for implementation.

Operating efficiency of turbines is a result of wicket gate opening and blade angle for a given head (Bell 1981). As a result, there is a family of turbine efficiency curves for each project (or turbine design) for various head differentials. Operational decisions affecting turbine operations are based on efficiency curves for incremental changes in head, as provided by turbine manufacturers or empirical testing.

B. Guidelines

Objective: To reduce the mortality of outmigrating juvenile salmonids, BPA will provide the Corps' hydrosystem projects with generation requests that allow turbines at the Lower Snake (LSN) and Lower Columbia (LCOL) projects to operate within one percent of peak efficiency, or as otherwise specified, during the Peak Efficiency Operating Period, within the guidelines outlined below.

1. Peak Efficiency Operating Period.
This period is defined as 24 hours per day from March 15 through October 31 for the LCOL river projects and through November 30 for the LSN river projects.

During the period from April 1 through August 31, BPA will maintain generation requests that allow turbines to operate within 1 percent of peak efficiency in accordance with these guidelines, subject to the limitations listed in C.

During the period from March 15 through March 31, and September 1 through October 31 for the LCOL river projects and through November 30 for the LSN river projects, BPA will maintain generation requests that allow turbines to operate within 1 percent of peak efficiency in accordance with these guidelines; however, operation may occur outside 1 percent of peak efficiency subject to the limitations listed in C and D.

Reporting of generation requests outside the 1 percent peak efficiency range relative to the applicable peak efficiency limitations during the Peak Efficiency Operating Period will be provided as outlined in E.

2. Unit Priorities.
The Corps should make every effort to adhere to unit priorities. The Corps shall follow a unit priority list that specifies which units at each LSN and LCOL project should be operated within the range of peak efficiency, to minimize impact to salmon stocks. Likewise, the Corps will also indicate the priority for operating units outside the one percent peak efficiency minimum or maximum ranges. The list will be based on the best available fish passage and turbine efficiency information, developed by the Corps in coordination with the Fish Facility Operations and Maintenance Committee, and will be included in the FPP.

The Corps will coordinate and communicate any changes to the unit priority list prior to implementing a prioritized operation per the coordination process outlined

in B.4.

3. Project Priorities.
If units must be operated out of the 1 percent peak efficiency range, then BPA will make every effort to assure that generation requests to the Corps projects adhere to project priorities. Project priority will be developed weekly, based on in-season fish passage information, in coordination with NMFS and the Fish Passage Center.. Project priority will then be coordinated with the action agencies (BPA, Corps, Bureau of Reclamation (BOR)) through the process outlined in B.4.

4. Coordination.
Coordination processes should facilitate implementation by taking advantage of pre-existing interagency coordinating mechanisms (such as the COE, BOR, BPA and NMFS in-season mangement process, as described in the 1995 Biological Opinion on Operation of the Federal Columbia River Power System (FCRPS).

Coordination is also intended to minimize frequent disruption of FCRPS by allowing the action agencies sufficient lead time to include system operational changes in their planning activities. Sufficient time is defined as a minimum of two working days before implementation, unless an emergency situation exists. In the event of an emergency, implementation will begin as soon as practical given concurrent operations, hydraulic situations and loads.

Reasonable and prudent operation outside of peak efficiency for limitations listed in C.1 and C.2 below is at the discretion of the BPA and Corps. BPA and the Corps will coordinate with NMFS when operation of turbines outside of the peak efficiency range may be appropriate under provisions C.3 through C.9. Coordination will occur during the weekly in-season management team meetings, as described in the 1995 Biological Opinion on Operation of the FCRPS.

Emergency situations, described in limitations C1 and C2 below, that require an immediate change in FCRPS operation to avoid excessive take of listed salmonids may be directly coordinated at any time between NMFS and the action agencies. Coordination of an emergency change in FCRPS operation shall normally be completed immediately, with information supplied to the in-season managment team described above as soon as practicial. Implementation of the change(s) will occur as soon as practical given operational, hydraulic and load conditions. The action agencies shall provide points of contact to allow such emergency coordination to occur.

C. Limitations for the period March 15 through October 31 for the LCOL river projects and through November 30 for the LSN river projects

Conditions that may affect BPA's ability to operate in such a manner include:

1. System Reliability.
   BPA's ability to operate the power system in a manner that enables the Corps to maximize operation of turbines within peak range will be constrained by requirements to maintain system reliability (including requirements necessary for transient and voltage stability of the transmission system), and the ability to meet system response criteria. Additionally, it is necessary to maintain a margin of resource generation on line to fulfill Northwest Power Pool (NWPP), Western System Coordinating Council (WSCC), and the North American Electric Reliability Council (NERC) reliability requirements.

   BPA's Reliability Criteria for Operations, the Northwest Power Pool Operating Manual, the Western Systems Coordinating Council Operations Committee Handbook, and the North American Electric Reliability Council Operating Manual define system response criteria and margin of resource generation.

   Predictable instances of deviation from within the peak range as a consequence of prudent utility operation for control of short term system dynamics include:

   -Routine responses to loss of generation, load or transmission within the interconnection including delivery of Operating Reserve Obligation to NWPP members upon request. The duration of these deviations is minimal, but dependent upon recovery by the interconnection member with the problem.

   -Routine starting and stopping of generation units. These deviations are unavoidable, but very short in duration.

   -Deliberate dropping of generation, i.e., instantaneous interruption of output, to preserve system integrity. This dropping could cause a brief excursion.

2. Firm and Direct Service Industry (DSI) load.
   The LCOL and LSN projects will be operated within one percent of peak efficiency to the extent that the ability to meet firm loads is not jeopardized. According to the Regional Act, the Power Sales Contract with the DSI's and House Report 96-976 dated September 16, 1980," the total DSI load will be considered firm for purposes of resource operation."

3. Gas Supersaturation.
   Total dissolved gas saturation levels will be monitored at each project during the

fish passage season. Signs of gas bubble disease will be monitored at all Smolt Monitoring Program sampling sites and selected in-river sites. Peak turbine efficiency operation may be modified if representative monitoring data indicate that gas saturation is affecting fish survival. Necessary operational modifications will be coordinated through the process outlined in B.4, above.

4. Coordinated fishery operations.
In the event that coordinated fishery operations and approved fishery research are not in accord with operating turbines at peak efficiency, operational modifications will be coordinated through the process outlined in B.4.

5. Grand Coulee (GCL) and Chief Joseph (CHJ) flexibility.
Within system reliability and firm load limitations, flexibility at GCL and CHJ will be fully used, whenever possible, before generation requests to LCOL and LSN projects are outside the peak efficiency range.

6. Flow augmentation operations.
Flow augmentation requests for LCOL flows at McNary (MCN) are primarily met by water releases from GCL. The decision on whether to use GCL flexibility to provide inflows to MCN at the level necessary to meet the week's LCOL flow request when fish collection is maximized for transport during the flow augmentation period shall be made through the coordination process outlined in B.4.

   In-season management team flow augmentation requests for flows may exceed the one percent peak efficient operation range at LCOL/LSN projects. Meeting this flow request will take precedent over peak efficient operations. Coordination of the implementation of the flow requests will occur through the process outlined in B.4.

7. Transport projects.
Resolution of the conflict between spill management and turbine operation within one percent of peak efficiency at transport projects during the transport season shall be determined through the coordination process outlined in B.4, and in accordance with fish transportation guidelines, based on in-season flow and fish passage information. Care should be taken during transition periods close to the upper flow boundary to avoid frequent switching of priorities between spill and generation.

8. Routine maintenance and testing.
All units at all projects must undergo maintenance and associated testing. The testing necessitates deviation from the 1 percent peak efficiency band for periods of from 15 minutes to 8 hours. Scheduling of maintenance testing will be

coordinated through the process outlined in B.4 above, to ensure that it is conducted during times of low fish passage within a day to minimize impacts on fish.

9. Flood Control.

The FCRPS provides multiple benefits to the region. Flood control is a primary function of many of the projects on the Columbia River. In the event that river flow conditions require flood control operations, operation of turbines within the 1% peak efficiency range may be modified or suspended based on the Corps' direction. Allowing excursions from 1% peak efficiency for flood control operations would facilitate transportation, reduce excessive dissolved gas levels, and lower the risk of gas bubble disease in fish. Coordination of flood control operations will occur as outlined in B.4. See also Limitations C.3 and C.5.

During flood control operation, compliance reporting will follow procedures outlined in Section E.2.

D. Limitations for the period March 15 through March 31, and September 1 through October 31 for the LCOL river projects and through November 30 for the LSN river projects.

Conditions that may affect BPA's ability to operate in such a manner include all limitations in C.1 through C.9, plus the requirement for prudent use of the FCRPS storage capability necessary to import energy into the FCRPS for fish storage and firm load requirements.

E. Quality Control

The purpose of compliance reporting is to provide quality control for implementation of the Guidelines. BPA will consolidate information for the reports from BPA's system operation data, data provided by Corps project operators at LCOL and LSN projects, as well as other appropriate data sources.

BPA will provide these reports to NMFS, the FPC, and the Corps on a semi-monthly basis (mid-month and end-of-month). Amended reports will be provided where subsequent data indicates errors in previously reported information. Excursions outside 1% due to unknown causes will also be documented.

The reports compiled by BPA will summarize reportable events on a per project basis for each reporting period, as allowed under limitations listed in Section C of these Guidelines. Reportable events include: (1) 1% excursions of greater than 15

minutes in duration; and (2) more than five, five minute excursions within a day.

1. Normal river operation. BPA will consolidate information and prepare three reports per month: a mid-month and end-of-month report on individual excursions, and an end-of-month report describing the ratio of project time outside the 1% peak efficiency range to total turbine unit operating time.

A brief explanation of the reason(s) for unit operation outside the peak efficiency range, the date, and the associated period of time will also be provided for documented excursions. Other excursions (e.g., excursions for unknown reasons) will also be reported.

2. Flood Control operation. During flood control operations, tracking individual 1% excursions becomes difficult and time consuming, and, because system flexibility is greatly reduced under these conditions, does not provide NMFS, BPA and the Corps with useful information to manage the system.

When the Corps has declared a flood control operation, compliance reporting will be limited to a diel (daylight vs. night-time) measurement of the gross ratio of total hours not within the 1% peak efficiency range (N1%) to total hours generating. Reports of this measure will be done on a project basis. BPA will consolidate the information, from sources described above, to track this ratio on a semi-monthly basis. Information will be distributed as noted above.