SECTION 6

ICE HARBOR DAM

Ice Harbor Dam

1. Fish Passage Information. The locations of fish passage facilities are shown on the general site plan for Ice Harbor Lock and Dam in Figure IHR-1. Dates of project operations for fish purposes and special operations are listed in Table IHR-1.

1.1. Juvenile Fish Passage.

1.1.1. Facilities Description. The juvenile fish passage facilities at Ice Harbor consist of standard length STSs, vertical barrier screens, 12" orifices, collection channel and dewatering structure, sampling facilities, and transportation flume/pipe to the tailrace below the project.

1.1.2. Juvenile Migration Timing. Juvenile passage timing at Ice Harbor Dam corresponds closely with juvenile passage at Lower Monumental Dam. Maintenance of juvenile fish passage facilities is scheduled during the winter maintenance periods detailed in the facility operating criteria and project maintenance sections.

1.2. Adult fish Passage.

1.2.1. Facilities Description. The adult fish passage facilities at Ice Harbor are made up of separate north and south shore facilities. The north shore facilities include a fish ladder with counting station, a small collection system, and a pumped auxiliary water supply system. The collection system includes two downstream entrances and one side entrance into the spillway basin. In normal operation one downstream entrance is used and the other two entrances are closed. The auxiliary water is supplied by three electric pumps with all three pumps normally operated. The south shore facilities are comprised of a fish ladder with counting station, two south shore entrances, a powerhouse collection system, and a pumped auxiliary water supply system. The powerhouse collection system includes two downstream entrances and one side entrance into the spillway basin at the north end of the powerhouse, twelve floating orifices, and a common transportation channel. One of the downstream north powerhouse entrances and seven of the floating orifices are used during normal operation. At the south shore entrances, one entrance is normally used. The auxiliary water is supplied by eight electric pumps of which from six to eight are normally used to provide the required flows. The excess water from the juvenile fish passage facilities is routed into the fish pump discharge chamber to provide additional attraction flow.

Insert Figure IHR-1

Table IHR-1. Dates of project operations for fish purposes at Ice Harbor Dam, 2000.

1.2.2. Adult Migration Timing. Migrants are present at Ice Harbor year around. Maintenance of adult passage facilities is scheduled for January and February to minimize impacts on adult migrants. Table IHR-2 shows primary passage periods for each species and shows earliest and latest date of peak passage on record from fish count data compiled by the Corps of Engineers. Adult fish are counted from April 1 through December 15. From April 1 through October 31, adult fish are counted 24 hours per day. Fish are visually counted by fish counters 16 hours per day (from 0400 to 2000 hours Pacific Standard Time) with nighttime passage from 2000 to 0400 hours videotaped with later interrogation by fish counters. From November 1 through December 15, fish passage is videotaped 24 hours per day with later interrogation by fish counters.

Table IHR-2. Adult migration timing at Ice Harbor Dam from 1962-1999 based on fish counts.

Species	Counting Period	Date of Peak Passage	
		Earliest	Latest
Spring Chinook	4/1 - 6/11	4/24	5/26
Summer Chinook	6/12 - 8/11	6/12	7/23
Fall Chinook	8/12- 12/15	9/07	9/30
Steelhead	4/1 – 12/15	9/15	10/12
Sockeye	4/1 - 12/15	7/01	9/22

2. Project Operation.

2.1. Spill Management. Involuntary spill at Ice Harbor is the result of river flow exceeding powerhouse capacity, insufficient generation loads to pass the river flow, turbine unit outages (forced or scheduled), or the failure of a key component of the juvenile fish passage facility which forces the project to spill to provide juvenile fish passage. Spill at Ice Harbor will be distributed in accordance with the adult spill pattern listed in Table IHR-3. Special spills for juvenile fish passage may be provided as detailed in Appendix A (Special Project Operations and Research). Special spills for juvenile fish passage normally occur during the spring and summer, from April 3 through August 31.

2.2. Dissolved Gas Management and Control. Total dissolved gas TDG) levels at Ice Harbor are monitored in accordance with the Dissolved Gas Monitoring Program, Appendix D. The TDG will be monitored in the Ice Harbor forebay and tailrace. The TDG data will be collected every half-hour and transmitted hourly via computer year-round. Related data collected at the same time will be spill volume and total project flow. Implementation of requests for spill will be based in part upon TDG monitoring data along with juvenile migration data. Requests for spill will be

coordinated through the Technical Management Team (TMT).

2.3. Operating Criteria.

2.3.1. Juvenile Fish Passage Facilities. Operate from April 1 through October 31 for juvenile fish passage and from November 1 through December 15 for protecting adult fallbacks. The facilities should be operated according to the following criteria:

2.3.1.1. Winter Maintenance Period (December 16 through March 31). Check and maintain, as needed, the items listed below.

a. Forebay Area and Intakes.

1. Remove debris from forebay and gatewell slots.

2. Rake trash racks just prior to the operating season.

3. Measure drawdown in gatewell slots after cleaning trashracks and with STSs in place.

b. Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS).

1. Maintenance completed on all screens.

2. Inspect STSs prior to installation and operate one trial run (dogged off on deck) to ensure proper operation.

3. Log trial Run.

3. Inspect all VBSs at least once per year. Repair as needed.

c. Collection Gallery.

1. Water-up valve operating correctly.

2. Orifice lights are operational.

3. Orifices clean and valves operating correctly.

4. Netting along handrails maintained and in good condition. Repair or replace as needed.

5. Netting or covers over orifice chutes maintained and in good condition. Repair or replace as needed.

d. Dewatering Structure and Flume.

1. Inclined screen should be clean and in good condition with no gaps between screen panels, damaged panels, or

missing silicone.

2. Screen cleaning system (brush and air flush) maintained and operating correctly.

3. Overflow weirs should be maintained, tested, and operating correctly.

4. All valves should be operating correctly.

5. Flume interior should be smooth with no rough edges.

e. Sampling Facilities.

1. Flume dewatering structure should be maintained and in good operating condition with no holes or gaps between dewatering screen panels. Silicone sealer should be in good condition.

2. Flume drop gate should be maintained and in good operating condition.

3. The wet separator and fish distribution system should be maintained and ready for operation as designed.

4. All dewatering screens and seals in separator and flume must be in good condition with no holes or gaps between panels, or sharp edges.

5. All valves and switch gates maintained and in good operating condition.

6. All sampling equipment maintained and in good operating condition.

f. Avian Predation Areas (Forebay and Tailrace). Inspect bird wires and other deterrent devices and repair or replace as needed. Where possible, install additional bird wires or other deterrent devices to cover areas of known avian predation activity.

2.3.1.2. Fish Passage Period (April 1 through December 15).

a. Forebay Area and Intakes.

1. Remove debris from forebay.

2. Remove debris from trashracks as required to maintain less than 1' of additional drawdown in gate slots. Additional raking may be required when heavy debris loads are present in the river. Coordinate turbine unit outages with other project work activities, if possible, to minimize turbine unit

outages during the spring.

3. Inspect gatewell slots daily for debris, fish buildup, and contaminating substances (particularly oil). Clean gatewells before they become half covered with debris. If, due to the volume of the debris, it is not possible to keep the gatewell surfaces at least half clear, they should be cleaned at least once daily. If flows through an orifice give indications that an orifice may be partially obstructed with debris, the orifice will be closed and backflushed to remove the obstruction. If the obstruction can not be removed, the orifice shall be closed and the alternate orifice for that gatewell slot shall be operated. If both orifices become obstructed or plugged with debris, the turbine unit shall not be operated until the gatewell and orifices are cleared of debris.

4. If a visible accumulation of contaminating substances (such as oil) is detected in a gatewell and it cannot be removed within 24 hours, the gatewell orifices shall be closed and the turbine unit shut done until the material has been removed and any problems corrected. Action should be taken as soon as possible to remove the oil from the gatewell so the orifice can be reopened to allow the fish to exit the gatewell. Orifices shall not be closed for longer than 48 hours.

5. Dip bulkhead gatewell slots to remove fish prior to installing bulkhead for unwatering bulkhead slot.

b. Submersible Traveling Screens (STS) and Vertical Barrier Screens (VBS).

1. Operate STSs in cycling mode when average fork length of subyearling chinook or sockeye is greater than 120 mm at Lower Monumental collection facility.

2. Operate STSs in continuous operational mode when average fork length of subyearling chinook or sockeye is less than 120 mm at Lower Monumental collection facility, or if there is other evidence that smaller juvenile fish are present at the project.

3. Inspect each STS once per month.

4. Record STS amp readings daily.

5. If an STS or VBS is damaged or fails during the juvenile fish passage season, follow procedures detailed under unscheduled maintenance of STSs. In no case should a turbine unit be operated with a missing or a known non-operating or damaged STS or VBS.

6. Up to one-half of the STSs may be removed after October 1 for annual maintenance provided there is no operation of units without screens.

7. Make formal determination at end of season as to adequacy of STS screen mesh and replacement if necessary.

8. Inspect at least 2 VBSs at random across the powerhouse between the spring and summer migration periods. If a debris accumulation is noted, inspect other VBSs and clean debris as necessary.

c. Collection Gallery Checks.

1. Orifices clean and operating. Operate at least one 12" orifice per slot (preferably the north orifice). If the project is operating at MOP, additional orifices may be operated to maintain full collection channel.

2. Orifice lights operational and operating on open orifices.

3. Orifice jets hitting no closer than 3' from the opposite wall (bypass channel full).

4. Back flush orifices at least once per day and more frequently if required. During periods of high debris, orifices should be inspected and back flushed several times per day, as determined by the project biologist, to keep orifices clean.

5. Water-up valve operational.

6. The netting along handrails should be maintained in good condition with no holes or gaps in the netting. Repair or replace as needed.

7. Netting or covers over orifice chutes in good condition. Repair or replace as needed.

d. Dewatering Structure.

1. Trash sweep operating correctly. The frequency of sweep should be set as necessary to maintain a clean screen, with a minimum operation of at least once per hour. If automated cleaning system problems occur, operate manually at least once per work shift as feasible to maintain a clean screen.

2. Clean trapezoidal section at least once per day, and more frequently if required, to maintain a clean condition.

3. Check overflow weirs to make sure they are operating correctly, perform maintenance as required.

4. There should be no gaps between screen panels in the inclined screen or holes in the screen panels.

e. Sampling Facilities.

1. All screens should be inspected to make sure there are no holes or sharp edges.

2. Operate wet separator and fish distribution system as designed. Sample fish twice per week during the main juvenile bypass season to monitor juvenile fish descaling and other fish condition parameters. Provide information in project weekly report.

3. Crowder screen brushes should be maintained in good operating condition with no holes or sharp edges in the crowder screen.

4. Operate preanesthetic system as designed.

f. Avian Predation Areas (Forebay and Tailrace).

1. Bird wires and other avian deterrent devices should be monitored to assure they are in good condition. Any broken wires or devices should be replaced as soon as possible.

2. Harassment program in place to deter avian predation in areas actively used by birds and not covered by bird wires or other devices.

3. Project biologists shall routinely monitor project areas to determine areas of active avian predation and, if possible, adjust harassment program to cover these areas or install bird wires or other deterrent devices to discourage avian predation activities.

g. Inspection and Record Keeping. Inspect all facilities according to fish facilities monitoring plans. Record all maintenance and inspections.

2.3.2. Adult Fish Passage Facilities. Operate the adult fish passage facilities according to the following criteria.

2.3.2.1. Winter Maintenance Period (January 1 through March 1).

a. Inspect all staff gauges and water level indicators. Repair and/or clean where necessary.

b. Dewater all ladders and inspect all dewatered sections of fish facilities for projections, debris, or plugged orifices which could injure fish or impede fish passage up the ladder. Inspect all diffuser gratings and chambers annually by dewatering and physically inspecting the gratings and chambers or by using divers or video inspection techniques. All diffuser gratings and chambers are to be dewatered and physically inspected at least every 3 years. Repair deficiencies.

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

ladder exits.

d. Calibrate all mechanical water level sensing devices, as necessary, for proper facilities operations.

e. Inspect all spill gates and ensure that they are operable.

2.3.2.2. Fish Passage Period (March 1 through December 31). **[Note**: During extremely high flow periods when tailwater level exceeds elevation 363' msl, the fish pumps may have to be turned off so that the head differential on the auxiliary water supply conduit ceiling slab does not exceed structural design criteria.]

a. Fishway Ladders. Water depth over weirs: 1' to 1.3'

b. Counting Window Widths. Counting windows should be operated as far out as possible while maintaining adequate counting conditions. When possible, the minimum counting slot width should be 18". All equipment should be maintained and in good condition.

c. Head On All Entrances. Head range: 1' to 2'

d. North Shore Entrance (NEW 1). Elevation of top of gate when on sill = 332.25'.

1. Operate downstream gate closest to shore.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill. Note that at low river flow and tailwater, some of the diffusers are above tailwater and project may only be able to maintain a 6' weir depth.

e. North Powerhouse Entrance (NFE 1 and 2). Elevation of top of gate when on sill = 332.25'.

1. Operate 1 downstream gate.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill.

[**Note:** At low tailwater, weirs will bottom out and will be less than 8' below tailwater.]

f. Powerhouse Collection System. Operate 7 floating orifices (O.G. numbers 1, 2, 4, 6, 8, 10, and 12).

g. South Shore Entrance (SFE-1). Elevation of top of gate when on sill = 332.25'.

1. Operate entrance closest to powerhouse.

2. Weir depth: 8' or greater below tailwater. At tailwaters less than elevation 340.25', weirs should be on sill.

[**Note:** At low tailwater, weirs will bottom out and will be less than 8' below tailwater.]

h. Channel Transportation Velocity. 1.5' to 4' per second.

i. Head on Trashracks.

1. Maximum head of 0.5' on ladder exits.

2. Maximum head on picket leads shall be 0.3'.

j. Staff Gages and Water Level Indicators. Shall be readable at all water levels encountered during fish passage period. Repair or clean as necessary throughout the passage season.

k. Facility Inspections.

1. Powerhouse operators shall inspect facilities once per day. Maintain computerized fishway control system record keeping system.

2. Project biologists shall inspect facilities three times per week. Inspect all facilities according to fish facilities monitoring program.

3. Project personnel shall check computerized fishway control system twice per month to ensure that it is kept within calibrations.

4. Inspect fishways daily for foreign substances, (particularly oil). If substances are found, corrective actions should be undertaken immediately.

5. Record all inspections.

2.3.3. 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, from March 1 through December 31, summarizing project operations. The weekly reports should 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 that occurred at the

project that may effect fish passage. The weekly reports shall cover a Friday through Thursday time period and shall be sent to CENWW-OD-TF by noon the following Monday via electronic mail. Project biologists shall prepare a draft annual report by February 10 and a final report by March 15 summarizing the operation of the project fish passage facilities for the previous year. The annual report shall also include a description of all actions taken to discourage avian predation at the project, with an overview of the effectiveness of the activities in discouraging avian predation. Project biologists also inspect project facilities once per month and during dewaterings for the presence of zebra mussels. Biologists shall provide a report to CENWW-OD-TF on a monthly basis summarizing zebra mussel inspections.

3. Project Maintenance. Project biologists should be present to provide technical guidance at all project activities that may involve fish handling. All dewaterings shall be accomplished in accordance with approved project dewatering plans. Dewatering and fish handling plans were reviewed and revised in 1997 to ensure that they comply with Appendix G, Guidelines for Dewatering and Fish Handling Plans.

3.1. Juvenile Fish Passage Facilities.

3.1.1. Scheduled Maintenance. Scheduled maintenance of the juvenile facilities is conducted during the non-fish passage season from December 16 to March 31. Long-term maintenance or modifications to the facilities that requires them to be out of service is done during this period. During the fish passage season, the facilities are inspected on a daily basis to insure that they are operating correctly.

3.1.2. Unscheduled Maintenance. Unscheduled maintenance is the correction of any situation that prevents the facilities from operating according to criteria or that will impact fish passage and survival. Unscheduled maintenance of facilities such as submersible traveling screens, which sometimes break down during the fish passage season, will be carried out according to procedures described below. In these cases, repairs will be made as prescribed and CENWW-OP-TF notified for further coordination. Unscheduled maintenance that will have a significant impact on juvenile fish passage shall be coordinated with the CBFWA (through the FPC) and NMFS on a case-by-case basis by CENWW-OD-TF. Then CENWW-OD-TF will be notified as soon as possible after it becomes apparent that maintenance repairs are required. The Project Manager has the authority to initiate work prior to notifying CENWW-OD-TF when in his opinion delay of the work will result in an unsafe situation for people, property, or fish. Information required by CENWW-OD-TF includes:

a. Description of the problem.

b. Type of outage required.

c. Impact on facility operation.

d. Length of time for repairs.

e. Expected impacts on fish passage and proposed measures to mitigate them.

3.1.2.1. Submersible Traveling Screens (STS). The STSs are inspected periodically throughout the juvenile migration season with a video monitoring system. If an STS is found to be damaged it will be removed and either replaced with the spare STS or repaired and returned to service. A turbine unit shall not be operated with a known damaged or nonfunctioning STS or without a full compliment of STSs. If an STS fails on a weekend or at night when maintenance crews are not available, the respective turbine unit will be shut down and generation switched to another fully screened unit. If all screened turbine units are in service, additional water may be spilled until the effected STS can be removed and repaired or replaced.

3.1.2.2. Gatewell Orifices. Each gatewell has two 12" orifices with air operated valves to allow fish to exit the gatewell. Under normal operation, one orifice per gatewell is operated. To minimize blockage from debris, orifices are cycled and back flushed at least once per day, and more frequently if required by heavy debris loads. If an air valve fails or is blocked with debris, the valve should be closed and the alternate orifice for that gatewell operated until repairs can be made. If both orifices are blocked with debris or damaged, the turbine unit will be taken out of service until repairs can be made. If repairs are to take longer than 48 hours, juvenile fish will be dipped from the gatewell with a gatewell dip basket in accordance with the project dewatering and fish-handling plan.

3.1.2.3. Dewatering Structure. The dewatering structure acts as a transition from the collection channel to the corrugated metal flume. An inclined screen allows excess water to be bled off, with all fish and remaining water transitioning into the corrugated metal flume. The excess water is discharged into the adult fish facility auxiliary water supply system and is also used as the water supply for the sampling facilities. The dewatering structure contains a trash sweep for cleaning the rectangular portion of the inclined screen, and an air blow back system for cleaning the transition (trapezoidal) section of the screen. If the trash sweep breaks and interferes with juvenile fish passage through the structure or if the inclined screen or other component of the structure is damaged, the orifices may need be closed and the collection channel dewatered to allow repairs to be made. If the orifices are closed and the collection channel unwatered, the traveling screens will remain in operation. Fish will be allowed to accumulate in the gatewells for up to 2 days. If repairs are expected to take longer than 2 days, a salvage program will be initiated to remove

fish from gatewells, with a gatewell dip basket, until repairs can be made and the system watered up again. While the collection channel is out of service, project personnel shall monitor gatewells for signs of fish problems or mortality. Spill may be provided as an alternative avenue for fish passage during the collection channel outage.

3.1.2.4. Bypass Flume/Pipe. The bypass flume/pipe transports fish to the sampling facilities and to the tailrace below the project. If there is a problem with the flume/pipe that requires it to be unwatered, procedures will be taken similar to paragraph 3.1.2.3.

3.1.2.5. Sampling Facilities. Under normal operation, juvenile fish are routed around the sampling facilities, except when sampling is being conducted. If there is a problem with the sampling facilities when it is in operation, the drop gate will be lowered to keep all juvenile fish in the bypass flume/pipe to bypass them directly to the river below the project. All fish in the sampling facility will then be released back to the river prior to sampling if there are any problems with holding them in the sample tank until they can be sampled.

3.2. Adult Fish Passage Facilities.

3.2.1. Scheduled Maintenance. Scheduled maintenance of a facility which must be unwatered to work on or whose maintenance will have a significant effect on fish passage will be done during the January and February winter maintenance period. Maintenance of facilities that will not have a significant affect on fish passage may be conducted during the rest of the year. Maintenance is normally conducted on one fish ladder at a time during the winter to provide some fish passage past the project at all times. When facilities are not being maintained during the winter maintenance period, they will be operated according to normal criteria, unless otherwise coordinated with the fish agencies and tribes.

3.2.2. Unscheduled Maintenance. Unscheduled maintenance that will significantly effect the operation of a facility will be coordinated with NMFS and FPOM. Coordination procedures for unscheduled maintenance of adult facilities are the same as for juvenile facilities. If part of a facility malfunctions or is damaged during the fish passage season and the facility can still be operated within criteria without any detrimental affects on fish passage, repairs may not be conducted until the winter maintenance period or until fewer numbers of fish are passing the project. If part of a facility is damaged or malfunctions and may significantly impact fish passage, it will be repaired as soon as possible.

3.2.2.1. Fish Ladders and Counting Stations. The fish ladders

contain fixed weirs, counting stations with picket leads, and fish exits with trash racks. If any part of the ladder fails or is blocked with debris during the fish passage season, efforts will first be made to correct it without unwatering the ladder. Trash racks, picket leads, and counting stations can sometimes be repaired or maintained without unwatering the ladder. The decision on whether to unwater the ladder and make repairs during the fish passage season or wait until the winter maintenance period will be made after coordination with the fish agencies and tribes.

3.2.2.2. North Shore Auxiliary Water Supply System. The north shore facilities contain three electric pumps that provide auxiliary water to the diffusers at the bottom of the ladder and at the entrances. During normal operation two or three pumps are required, depending on the tailwater elevation, to provide the necessary auxiliary water. If a pump fails during a two-pump operation, the pump on standby will be operated to provide the necessary flows. If a pump fails during a three-pump operation, NEW1 will be raised until the required 1' to 2' head differential is achieved. If this cannot be met by the time the weir reaches 6' below tailwater, the gate will remain at that level regardless of the head. If two or all three pumps fail, the weir will be maintained at a level of 6' below tailwater until repairs are made.

3.2.2.3. South Shore Auxiliary Water Supply System. The south shore auxiliary water is supplied by eight electric pumps and 150 to 180 cfs of excess water from the juvenile fish passage facilities. Fluctuating tailwater levels require from six to eight pumps to be operated to provide the auxiliary water. If one pump fails, a standby pump will be started to keep the fishway within criteria. If more pumps fail, this procedure will continue until all the standby pumps are in operation. If criteria cannot be met, the floating orifices should be closed in the following order: OG-12, OG-10, OG-8, and OG-6. If the required head differential of 1' to 2' cannot be reached when the floating orifices are closed, SSE 1 and NFE 2 will be closed equally at 1' intervals until it is reached or until the weirs are 5' below tailwater. Then the remaining floating orifices should be closed in the following order: OG-4, OG-1, and OG-2. If there is still not enough auxiliary water to maintain the head differential on the two main entrances, NFE 2 will be closed, the transportation channel bulkheaded off at the junction pool, and SSE 1 operated as deep as possible to maintain the head differential. If it cannot be maintained at a depth of 6' or greater, the weir will remain at 6' regardless of the head.

3.2.2.4. Fishway Entrances. The fishway entrances are made up of main entrance weirs with hoists and automatic controls, and floating orifices which regulate themselves with tailwater fluctuations. If any of the automatic controls malfunction, the weirs can usually be operated manually by project personnel and kept within criteria. If there is a further failure, which

prevents the entrance from being operated manually, an alternate entrance will be opened until repairs can be made. If a floating orifice fails, it will be pulled out of the water and the entrance bulkheaded off until the floating orifice is repaired.

3.2.2.5. Diffuser Gratings: Diffuser chambers for adding auxiliary water to fish ladders and collection channels are covered by gratings attached by several different methods. Diffuser gratings are normally checked during the winter maintenance period to make sure they are in place. These inspections are done by either dewatering the fish passageway and physically inspecting the diffuser gratings, or by using underwater video cameras and divers or other methods to inspect the gratings. Diffuser gratings may come loose during the fish passage season due to a variety of reasons. Daily inspections of fish ladders and collection systems should include looking for any flow changes that may indicate problems with diffuser gratings. If a diffuser grating is known to or suspected of having moved, creating an opening into a diffuser chamber, efforts must immediately be taken to correct the situation and minimize impacts on adult fish in the fishway. Coordination of the problems should begin immediately through the established unscheduled maintenance coordination procedure (see paragraph 3.1.2). If possible, a video inspection should be made as soon as possible to determine the extent of the problem. If diffuser gratings are found to be missing or displaced, creating openings into the diffuser chambers, a method of repair shall be developed and coordinated with the fish agencies and tribes through the established coordination procedure. Repairs shall be made as quickly as possible unless coordinated differently.

4. Turbine Unit Operation and Maintenance.

4.1. Turbine Unit Operation. When in operation, turbine units will be operated to enhance adult and juvenile fish passage from March 1 through November 30. During these dates turbine units will be operated as needed to meet generation requirements in the priority order shown in table IHR-3. Model studies of Ice Harbor Dam show that spilling at lower river flows can cause eddying in front of the powerhouse. To provide the best fish passage conditions during periods of spill, it is extremely important that the turbine units operate in a specific operating order to minimize eddying conditions. Results from the model studies and preferred operations to reduce eddying are reflected in Table IHR-3.

Table IHR-3. Turbine unit operating priority for Ice Harbor Dam.

Season	Time of Day	Unit Priority*
March 1 - November 30 (Project NOT Spilling)	24 hours	1, 3, 4, 2, then 5 and 6 (any order)
March 1 - November 30 (Project IS Spilling)	Daytime (0600 to 1800 hours)	1, 3, 6, 4, 2, and 5
	Nighttime (1800 to 0600 hours)	3, 1, 6, 4, 2, and 5
December 1 - February 28	24 hours	Any Order

Note: If unit 1 is out of service, operate unit 2 in place of unit 1. If unit 3 is out of service, operate unit 4 in place of unit 3.

The hours of operations may be coordinated and adjusted in-season by CENWW-OD-TF (through coordination with TMT) if fish passage or other conditions at the project require it. Unit operating priority may be coordinated differently to allow for fish research, construction, or project maintenance activities. If a turbine unit is taken out of service for maintenance or repair, the next unit in the priority list shall be operated.

Turbine units will be operated within 1% of best efficiency from March 15 through November 30 (or as specified in BPA's load shaping guidelines, Appendix C) unless operation outside of that range is necessary to: 1) meet the load requirements of the BPA administrator whose load requests will be made in accordance with BPA's policy, statutory requirements, and load shaping guidelines, or 2) be in compliance with other coordinated fish measures. Project personnel shall record when turbine units are operated outside the 1% turbine efficiency range and shall provide the information to BPA on a weekly basis according to the load shaping guidelines. Between December 1 and March 15, turbine units will continue to be operated within the 1% turbine efficiency range except when BPA load requests require the units to be operated outside the 1% range.

Ranges for operation of the turbine units within 1% of best turbine efficiency at various heads are shown in Tables IHR-4 through IHR-6. The 1% turbine efficiency ranges for units 1-3 were calculated using results from 1994 index testing of turbine unit 3. Maximum generation of units 1 through 3 at 115% overload is 103 MW. The 1% best efficiency ranges for units 4-6 were calculated using results from January 1994 index testing on unit 6 and are with submersible traveling screens installed. Maximum generation of units 4 through 6 at 115% overload is 127 MW.

Table IHR-4. The 1% best efficiency ranges for turbine units 1-3 with standard length submersible traveling screens installed[a].

Head (Ft)	Lower Generator Limits	Upper Generator Limits

	(MW)	(CFS)	(MW)	(CFS)
85	50	7,801	74	11,708
86	50	7,838	76	11,763
87	51	7,874	77	11,818
88	52	7,919	78	11,886
89	53	7,955	80	11,939
90	54	8,000	81	12,006
91	55	8,044	82	12,073
92	56	8,079	84	12,125
93	57	8,123	85	12,191
94	58	8,166	86	12,256
95	59	8,210	88	12,321
96	59	8,253	89	12,386
97	60	8,286	91	12,436
98	61	8,329	92	12,500
99	62	8,371	93	12,564
100	63	8,414	95	12,627
101	64	8,455	96	12,690
102	65	8,497	98	12,753
103	66	8,548	99	12,830
104	67	8,590	101	12,892
105	68	8,631	102	12,954

[a] The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table IHR-5. The 1% best efficiency ranges for turbine units 1-3 without standard length submersible traveling screens installed[a].

Head (Ft)	Lower Generator Limits		Upper Generator Limits	
	(MW)	(CFS)	(MW)	(CFS)
85	50	7,897	85	13,448
86	51	7,934	87	13,512
87	52	7,971	88	13,575
88	53	8,017	90	13,653
89	54	8,053	92	13,714
90	55	8,098	93	13,791
91	56	8,143	95	13,868
92	56	8,178	96	13,928
93	57	8,223	98	14,003
94	58	8,267	99	14,079
95	59	8,311	101	14,153
96	60	8,354	103	14,212
97	61	8,388	103	14,065
98	62	8,431	103	13,922
99	63	8,474	103	13,781
100	64	8,517	103	13,644
101	65	8,559	103	13,508
102	66	8,602	103	13,376
103	67	8,653	103	13,246
104	68	8,695	103	13,119
105	69	8,737	103	12,994

[a] The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.

Table IHR-6. The 1% best efficiency ranges for turbine units 4-6 with standard length submersible traveling screens installed[a].

Head (Ft)	Lower Generator Limits		Upper Generator Limits[b]	
	(MW)	(CFS)	(MW)	(CFS)
85	58	9,174	122	19,234
86	59	9,222	123	19,194
87	60	9,157	124	18,925
88	60	9,132	125	19,037
89	61	9,121	127	18,900
90	62	9,167	127	18,692
91	63	9,155	127	18,486
92	64	9,258	127	18,285
93	64	9,128	127	18,089
94	65	9,172	127	17,896
95	66	9,151	127	17,708
96	67	9,189	127	17,524
97	67	9,058	127	17,343
98	68	9,225	127	17,166
99	69	9,201	127	16,992
100	70	9,248	127	16,823
101	70	9,167	127	16,656
102	71	9,207	127	16,493
103	72	9,191	127	16,333
104	73	9,241	127	16,176
105	73	9,166	127	16,021

[a] The turbine efficiency tables are being revised to reflect new information. These tables contain the best information currently available.
[b] If screens are not installed, upper generator limits are 10 MWs lower.

4.2. Turbine Unit Outages During High River Flow Periods. During high spring flows, turbine unit outages for inspecting fish screens, repairing research equipment such as hydroacoustic or radio telemetry equipment, and other fish items may cause increased spill at a project in order to maintain reservoirs levels within operating levels. This may result in TDG levels exceeding standards. It is important that this work be conducted when scheduled to ensure that facilities are working correctly and not injuring migrating fish, and that important fish research data is collected. To facilitate this work, reservoir storage may be utilized to minimize impacts from taking turbine units out of service and increasing spill. At Ice Harbor Dam, this special operation may take place when river flows are above 100 kcfs or when increasing spill levels will result in TDG levels exceeding standards. The activities covered under these operations will be coordinated with and approved by the TMT whenever possible.

For scheduled inspection or repair of research equipment, reservoirs shall be drafted to the bottom of MOP and allowed to fill to 1' above the MOP operating range as the work is accomplished. After the work, reservoirs will be slowly drafted back to the MOP operating range. When inspection or repair work can be scheduled ahead of time, the following process will be followed:

a. Project personnel shall schedule turbine unit outages through the approved turbine outage scheduling procedure by noon of the Tuesday of the week prior to the outage.

b. Project personnel shall also contact CENWW-OD-TF and Reservoir Control Center (RCC) by the same time period and inform them of the intended work.

c. Then RCC will coordinate the work activities with regional parties at the TMT meeting on the following Wednesday.

d. After coordination with the TMT, RCC shall issue a teletype through the CBTT issuing instructions to project and BPA personnel for the scheduled work.

e. Spill will be increased by one spill bay stop setting (about 1.7 kcfs) above passing inflow to slowly lower the level of Ice Harbor pool to the bottom of the MOP range prior to the scheduled work taking place.

f. When the work takes place, additional spill will not be provided and the reservoir will be allowed to refill until the reservoir is 1' above the normal MOP range (a 2' pondage from where the pool was when the work started). At this point, screen inspections shall be stopped. (At Snake River projects, this should allow about one normal work day for the scheduled work.)

g. At the conclusion of the work, the reservoir shall be

drafted back down to the MOP range utilizing a one spill bay stop increase in spill above passing inflow.

h. If work, such as screen inspections, is not finished, project personnel shall schedule another turbine unit outage for a date where it can be implemented again.

If the work that needs to be done is of an emergency nature that does not normally require the turbine unit to be taken out of service (such as a failed hydroacoustic transducer versus a failed fish screen), and can not wait for the above process to be implemented, project personnel shall notify CENWW-OD-TF and RCC to get approval to do the work. If approval to do the work is given, the turbine unit shall be taken out of service and the reservoir level allowed to increase until it reaches 1' above the MOP operating range. At this point, the turbine unit must be returned to service and the reservoir will be drafted back to the MOP range using one spill bay stop setting above passing inflows.

4.3. Turbine Unit Maintenance. The project turbine unit maintenance schedule will be reviewed annually by project and Operations Division biologists for fish impacts. If possible, maintenance of priority units will be scheduled for non-fish passage periods, or when there are low numbers of fish passing the project. Each turbine unit requires annual maintenance that may take from several days to two weeks. Annual maintenance of all turbine units is normally scheduled during the mid-July to late November time frame. The maintenance of priority units for adult passage is normally conducted in mid-August, when fewer adults are migrating, to minimize impacts on migrating adults. Turbine units may occasionally require overhauls to repair major problems with the turbine or generator. Overhauls may take over one year to accomplish. Turbine units, governors, exciters, and control systems require periodic maintenance, calibration, and testing which may take them outside of the 1% turbine efficiency range. This work will be scheduled in compliance with BPA load shaping guidelines (Appendix C) to minimize impacts on juvenile fish.

Unwatering turbine units should be accomplished in accordance with project dewatering plans. Prior to dewatering a turbine unit for maintenance, the turbine unit should be spun at speed-no-load, if possible, immediately before installing tailrace stoplogs and headgates to minimize the number of fish in the draft tube and scroll case. If a turbine unit is out of service for maintenance for an extended period of time without tailrace stoplogs in place, efforts should be made to not open the wicket gates if the scroll case must be dewatered at a later date without the unit being spun before hand.

5. Forebay Debris Removal. Debris at projects can impact fish passage conditions. Debris can plug or block trash racks, VBSs, gatewell orifices, dewatering screens, separators, and facility

piping resulting in impingement, injuries, and descaling of fish. Removing debris at its source in the forebay is sometimes necessary to maintain safe and efficient fish passage conditions, navigation, and other project activities. Debris can be removed from the forebay by: physically encircling the debris with log booms and pulling it to shore with boats where it can be removed with a crane, removing the debris from the top of the dam using a crane and scoop, or passing the debris through the spillway with special powerhouse operations and spill. The preferred option is to remove debris at each project when possible to avoid passing debris on to the next project downstream. This is not always possible at each project, as some projects do not have forebay debris removal capability. In this case, the only viable alternative is to spill the debris.

All special spills (other than normal spill patterns for ongoing spill operations) and project operations for passing debris will be coordinated prior to the operations taking place. Each project shall contact CENWW-OD-TF at least two work days prior to the day they want the special project operations for spilling to pass debris. CENWW-OD-TF shall coordinate the special operations with RCC and NMFS. Project personnel shall provide CENWW-OD-TF the reason for the debris spill request, including an explanation of project facilities being impacted by the debris, the date and time of the requested spill, and any special powerhouse or other operations required to move the debris to the spillway. When a debris spill is coordinated and approved, RCC shall issue a teletype detailing the specifics of the special operations.

Table IHR-7. Ice Harbor daytime adult fish passage spill pattern with deflectors in all spill bays.

Spill Bay										Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10		
1										1	1.7
1									1.5	2.5	3.5
1	1								1.5	3.5	5.2
1	1							1	1.5	4.5	6.9
1	1	1						1	1.5	5.5	8.7
1	1	1					1	1	1.5	6.5	10.4
1	1	1	1				1	1	1.5	7.5	12.1
1	1	1	1			1	1	1	1.5	8.5	13.8
1	1	1	1	1		1	1	1	1.5	9.5	15.6
1	1	1	1	1	1	1	1	1	1.5	10.5	17.3
1	1	1	1	1	1	1	1	1	2	11	19.0
1	2	1	1	1	1	1	1	1	2	12	20.7
1	2	2	1	1	1	1	1	1	2	13	22.5
1	2	2	2	1	1	1	1	1	2	14	24.2
1	2	2	2	2	1	1	1	1	2	15	25.9
1	2	2	2	2	2	1	1	1	2	16	27.6
1	2	2	2	2	2	2	1	1	2	17	29.3
1	2	2	2	2	2	2	2	1	2	18	31.1
1	2	2	2	2	2	2	2	2	2	19	32.8
2	2	2	2	2	2	2	2	2	2	20	34.5
2	3	2	2	2	2	2	2	2	2	21	36.2
2	3	3	2	2	2	2	2	2	2	22	37.9
2	3	3	3	2	2	2	2	2	2	23	39.6
2	3	3	3	3	2	2	2	2	2	24	41.3
2	3	3	3	3	3	2	2	2	2	25	43.0
2	3	3	3	3	3	3	2	2	2	26	44.7
2	3	3	3	3	3	3	3	2	2	27	46.4
2	3	3	3	3	3	3	3	3	2	28	48.1
2	4	3	3	3	3	3	3	3	2	29	49.8
2	4	4	3	3	3	3	3	3	2	30	51.5
2	4	4	4	3	3	3	3	3	2	31	53.2
2	4	4	4	4	3	3	3	3	2	32	54.9
2	4	4	4	4	4	3	3	3	2	33	56.6
2	4	4	4	4	4	4	3	3	2	34	58.3
2	4	4	4	4	4	4	4	3	2	35	60.0
2	4	4	4	4	4	4	4	4	2	36	61.7
2	5	4	4	4	4	4	4	4	2	37	63.4
2	5	5	4	4	4	4	4	4	2	38	65.1
2	5	5	5	4	4	4	4	4	2	39	66.7
2	5	5	5	5	4	4	4	4	2	40	68.4

Table IHR-7. Ice Harbor daytime adult fish passage spill pattern with deflectors in all spill bays (continued).

Spill Bay										Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10		
2	5	5	5	5	5	4	4	4	2	41	70.1
2	5	5	5	5	5	5	4	4	2	42	71.8
2	5	5	5	5	5	5	5	4	2	43	73.5
2	5	5	5	5	5	5	5	5	2	44	75.1
2	6	5	5	5	5	5	5	5	2	45	76.8
2	6	6	5	5	5	5	5	5	2	46	78.5
2	6	6	6	5	5	5	5	5	2	47	80.2
2	6	6	6	6	5	5	5	5	2	48	81.8
2	6	6	6	6	6	5	5	5	2	49	83.5
2	6	6	6	6	6	6	5	5	2	50	85.2
2	6	6	6	6	6	6	6	5	2	51	86.8
2	6	6	6	6	6	6	6	6	2	52	88.5
2	7	6	6	6	6	6	6	6	2	53	90.1
2	7	7	6	6	6	6	6	6	2	54	91.7
2	7	7	7	6	6	6	6	6	2	55	93.3
2	7	7	7	7	6	6	6	6	2	56	94.9
2	7	7	7	7	7	6	6	6	2	57	96.5
2	7	7	7	7	7	7	6	6	2	58	98.1
2	7	7	7	7	7	7	7	6	2	59	99.7
2	7	7	7	7	7	7	7	7	2	60	101.3
2	8	7	7	7	7	7	7	7	2	61	103.0
2	8	8	7	7	7	7	7	7	2	62	104.7
2	8	8	8	7	7	7	7	7	2	63	106.4
2	8	8	8	8	7	7	7	7	2	64	108.1
2	8	8	8	8	8	7	7	7	2	65	109.8
2	8	8	8	8	8	8	7	7	2	66	111.5
2	8	8	8	8	8	8	8	7	2	67	113.2
2	8	8	8	8	8	8	8	8	2	68	114.9
2	9	8	8	8	8	8	8	8	2	69	116.5
2	9	9	8	8	8	8	8	8	2	70	118.1
2	9	9	9	8	8	8	8	8	2	71	119.7
2	9	9	9	9	8	8	8	8	2	72	121.3
2	9	9	9	9	9	8	8	8	2	73	122.9
2	9	9	9	9	9	9	8	8	2	74	124.5
2	9	9	9	9	9	9	9	8	2	75	126.1
2	9	9	9	9	9	9	9	9	2	76	127.7
2	10	9	9	9	9	9	9	9	2	77	129.3
2	10	10	9	9	9	9	9	9	2	78	130.9
2	10	10	10	9	9	9	9	9	2	79	132.5
2	10	10	10	10	9	9	9	9	2	80	134.1

Table IHR-7. Ice Harbor daytime adult fish passage spill pattern with deflectors in all spill bays (continued).

Spill Bay										Total Stops	Total Spill (kcfs)
1	2	3	4	5	6	7	8	9	10		
2	10	10	10	10	10	9	9	9	2	81	135.7
2	10	10	10	10	10	10	9	9	2	82	137.3
2	10	10	10	10	10	10	10	9	2	83	138.9
2	10	10	10	10	10	10	10	10	2	84	140.5
2	11	10	10	10	10	10	10	10	2	85	142.2
2	11	11	10	10	10	10	10	10	2	86	143.9
2	11	11	11	10	10	10	10	10	2	87	145.6
2	11	11	11	11	10	10	10	10	2	88	147.3
2	11	11	11	11	11	10	10	10	2	89	149.0
2	11	11	11	11	11	11	10	10	2	90	150.7
2	11	11	11	11	11	11	11	10	2	91	152.4
2	11	11	11	11	11	11	11	11	2	92	154.1
2	12	11	11	11	11	11	11	11	2	93	155.7
2	12	12	11	11	11	11	11	11	2	94	157.3
2	12	12	12	11	11	11	11	11	2	95	158.9
2	12	12	12	12	11	11	11	11	2	96	160.5
2	12	12	12	12	12	11	11	11	2	97	162.1
2	12	12	12	12	12	12	11	11	2	98	163.7
2	12	12	12	12	12	12	12	11	2	99	165.3
2	12	12	12	12	12	12	12	12	2	100	166.9
2	13	12	12	12	12	12	12	12	2	101	168.5
2	13	13	12	12	12	12	12	12	2	102	170.1
2	13	13	13	12	12	12	12	12	2	103	171.7
2	13	13	13	13	12	12	12	12	2	104	173.3
2	13	13	13	13	13	12	12	12	2	105	174.9