# ADULT AND JUVENILE FISH FACILITY MONITORING REPORT
# ICE HARBOR DAM
# 2010

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## INTRODUCTION

This report summarizes the operation and maintenance of the adult and juvenile fish passage facilities at Ice Harbor Dam in 2010. The juvenile fish sampling program and results are given in greater detail in the 2010 Juvenile Fish Transportation Program Annual Report.

## RIVER CONDITIONS

Peak river flow at Ice Harbor Dam occurred June 6 reaching 216.4 kcfs. River flows continually exceeded 100 kcfs June 3 – June 22. Spill for juvenile fish passage began April 3 and continued through August 31. Water temperatures taken at and during the juvenile sample season (April 6 – July 1) ranged from 47.5 degrees Fahrenheit in early April to 60.8 degrees Fahrenheit July 1st.

## ADULT FISH FACILITY

### Facility Description

The adult fish passage facilities at Ice Harbor are comprised of separate north and south shore systems. The north shore facilities include a fish ladder with a counting station, an adult fish collection channel, and a three-pump auxiliary water supply system. The collection system includes two downstream entrances near the navigation lock wall at the base of the dam, and one side entrance into the spillway basin. The downstream entrance nearest the navigation lock wall is normally open for fish passage, and the other two entrances are closed. Three electric pumps supply the auxiliary water for fish attraction flow. Two of the three pumps operate continuously during normal operation. The third pump serves as a backup in the case of a pump failure.

The south shore facilities are comprised of a fish ladder with a 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 fish transportation channel. The fishway entrances used during normal operation include: one south shore entrance nearest the powerhouse, one downstream north powerhouse entrance, and four

operating floating orifices. Eight electric pumps are available to supply the auxiliary water for fish attraction. In addition, excess water from the juvenile fish bypass system (approximately 200-270 CFS depending on forebay head) is added to the south shore fish pump discharge chamber from April 1 through December 15.

## Operations and Maintenance

The juvenile collection channel was dewatered for annual maintenance. Repairs to caulking, juvenile collection channel netting, damaged Plexiglas orifice covers, and screen cleaner brush replacement were accomplished during the winter outage. In addition, a new electrical power cable to the screen cleaner was installed. The primary dewatering screen was inspected along with the supporting structure underneath. Two wooden baffle boards under the incline screen were found to be rotten and were replaced. A zebra mussel inspection was performed, none were found. The concrete in the juvenile collection channel concrete is continuing to deteriorate in places. No other problems were found during the juvenile collection channel inspection. The upper south fish ladder was dewatered for annual maintenance January 19 to February 25, 2010. A small section of concrete (approximately 2 feet x 1 foot x 3 inches deep) is missing from the bottom one of the weir sections of the south fish ladder. On March 2, 2010 the south upper fish ladder diffuser staff gage indicated 0.9 feet (criteria is 1.0 – 1.3 feet). The diffuser valve could not be operated in automatic to adjust for more water. Maintenance believed the problem was with the diffuser valve. To fix the valve would have required unwatering the upper south adult fish ladder. Manually operating the valve could have caused the valve to fail entirely. With spring Chinook approaching, it was decided to leave the valve as is for the season and to make repairs during the winter maintenance period. No other problems were found during the upper south fish ladder inspection. The lower south fish ladder was unwatered and visually inspected. No problems were found. While the south fish ladder was unwatered, a series of plates were installed to aid lamprey passage. The north shore fish ladder was dewatered for annual inspection and maintenance January 4 - 13, 2010. The lower north fish ladder was inspected by underwater video. No problems were found. Maintenance work performed on both ladders and juvenile collection channel included: debris removal, picketed lead and staff gage cleaning, adult fish counting/viewing window cleaning, and maintenance of auxiliary water supply pumps.

Areas that were dewatered in 2010 season that required fish removal are listed below.

| | |
|---|---|
| January 4 | Upper North Fish Ladder |
| January 19 | Upper South Fish Ladder |
| January 22 | Lower South Fish Ladder |
| May 11 | Navigation Lock Tainter Valve #4 Area |
| October 21 | Turbine Unit 3 Draft Tube |
| December 7 | Turbine Unit 4 Draft Tube |
| December 20 | Juvenile Fish Collection Channel |

The total estimated number of fish handled during unwatering events in the 2010 season was 236. The species composition of the fish handled was 92 adult steelhead, 5 adult Chinook salmon,

103 juvenile steelhead, 17 juvenile Chinook salmon, 2 adult sturgeon, 4 juvenile sturgeon, 11 catfish, 1 sucker, and 1 smallmouth bass.

## Modifications

Modifications were made to the adult south fish ladder for lamprey passage this year. Steel plates were placed over the diffuser gratings above the junction pool. These plates should provide easier passage across the once grated areas that are no longer operated for water inflow into the adult fish ladder. The now covered gratings are located upstream of the junction pool and continue up to the first turn in the ladder at roadway elevation. In addition, all 8 south fish pump motors were replaced with new motors.

## Adult Fish Trap Operation

The adult fish trap was not operated in 2010.

## Auxiliary Water Supply System

All three fish pumps on the north shore and eight on the south shore were available for operation in 2010 with the exceptions listed below. The south fish pump motors have been replaced this year. During the south fish pumps motor replacement, 5 of the 8 south fish pumps were operated maintaining criteria in the south adult fishway. The north shore two pump operation makes the third north fish pump a backup. This allows normal two pump operation in the event one pump needs to be placed out of service. Each north shore fish pump operates at 350 CFS and each south shore fish pump operates at 300 CFS. In addition, approximately 270 CFS is added to the south adult fish pump chamber from excess water in the juvenile collection channel.

| | |
|---|---|
| NFP 3 Lower Guide Bearing | December 14 – January 11 |
| SFP 4 OOS for gearbox repair | December 28 – April 21 |
| All NFP off for fish ladder inspection | January 4 – January 13 |
| All SFPs off for fish ladder inspection | January 19 – February 25 |
| SFP 6 OOS for rebuilt gearbox installation | April 15 – April 19 |
| All SFP's off from 1052 hrs. to 1755 hrs. due to tailwater exceeding 353.0 feet. | June 8 |
| NFP 1 and 2 tripped due to oil lubrication trouble. | June 16 |
| NFP 2 three intermittent outages due to problems with lube system | June 18 – June 24 |
| NFP 2 OOS 1003 hrs. to 1252 hrs. to replace Contacts in lube system | June 29 |
| NFP 2 OOS due to lube oil system failure | July 2 - July 6 |
| NFP 1 OOS due to lube oil system failure | July 7 - July 8 |
| SFP 5 OOS due to lube oil system failure | July 9 – July 12 |
| SFP 4 OOS for repairs due to excessive noise from the motor bearings | July 23 |

| | |
|---|---|
| SFP 5 OOS due to lube oil system failure | July 25 – July 26 |
| NFP 1 OOS 1155 hrs. to 1305 hrs. due to low oil pressure | July 27 |
| SFP 1 OOS for repairs due to an oil leak | August 14 – August 16 |
| SFP 6 OOS for repairs due to an oil leak | August 18 – August 19 |
| SFP's 4 and 6 OOS for motor replacement | August 26 |
| SFP 5 OOS for motor replacement | August 27 |
| SFP 3 OOS for motor replacement | September 7 |
| | |

## Adult Fishway Inspections

### Visual inspections

The Corps project fishery personnel conducted visual inspections of the adult fishways during the fish passage season March through December. In addition, the powerhouse operators conducted daily inspections of the fishways. Fishery personnel averaged 5 inspections each week with 178 inspections completed from March 1 through December 30. The inspections were conducted by visually inspecting various areas of the fishways and recording readings on a data form from staff gages, fishway entrance hoists motor selysns, and if needed tape measures. The data was subsequently transferred to a computer spreadsheet (Appendix 2). In addition, an estimate of the amount of debris that accumulated near the fish ladder exits and in the gate wells was made during each visual inspection. When the fishway was out of criteria, the powerhouse operator was informed to make adjustments to the fishway control system or arrange for repairs if needed.

### Automated Fishway Control System

In the 2010 Fish Season, Ice Harbor sensed water levels with a sonar based level sensing system manufactured by Milltronics using the Multi Ranger model. This signal was sent to a Programmable Logic Control Center (PLC) that processed the signals from the Multi Ranger then displayed the reading on a screen in the Control room and if needed sent a signal to raise or lower one of the three weirs in services. The automated fishway control system consists of a PLC which interfaces with process level controllers. The remote terminal units control the fishway weir gates according to set points that either controls the gate at a depth below tailwater or a channel to tailwater head differential. A printout from the printer in the control room contains the following information: date; time (hour, minutes, and seconds); channel temperature; channel and tailwater elevation in feet above mean sea level (MSL) for the north shore, north powerhouse and south shore; elevation in feet above MSL for the fishway entrances; water depth at the fishway entrances; channel/tailwater differential; and set points for the fishway entrances and the channel/tailwater differential.

The readings from the automated fishway control system printout were recorded and compared to the visual inspection results to ensure that the fishways were operated within criteria. The automated control system was calibrated bi-monthly to ensure its accuracy. The time difference between reading the staff gage and collecting the computer printout in the control room may have been as much as 120 minutes. The time difference between the automated and visual readings may

give different inspection results due to operational changes, such as spill, switching units, and other water elevation fluctuations.

**Inspection Results**

Overall fishway performance (percent in criteria) was very similar in 2009 when compared to that of 2008. Reducing the number of powerhouse floating adult fish entrance orifices last year increased available water in the powerhouse collection channel and allowed the south and center fish entrance weirs to operate in criteria more often. However, water elevations readings during spill at the staff gages can vary as much as 1 foot on either side of the average elevation. This condition significantly contributes to incorrect visual readings falsely indicating an out of criteria event. Another contributor to out of criteria events is the location of the staff gages in relationship to the water level sensing equipment. Some staff gages are located several feet from the target area to be regulated. This condition makes accurate calibration impossible due to the relationship between the sensing equipment and the staff gage not being linear. The Project is pushing ahead with correcting this problem by the current upgrade to sonar water level detecting devices and moving the staff gages to the proper positions in the near future.

South Shore Entrance (SFE): The 2010 SFE weir gate percent in criteria $\geq$ 8 feet (81.4%) greater than 2009 (56.3%). The 2010 SFE percent in criteria on sill events (37.6%) was also greater than 2009 (33.6%). Most of the out of criteria occurrences can be attributed to unit operation changes, spill, and difficulty in reading staff gages due to fluctuations in water elevation, lower tailwater conditions, and discharges from the navigation lock.

North Powerhouse Entrance (NFE): The 2010 NFE weir gate percent in criteria a $\geq$ 8 feet (78.1%) was greater than 2009 (64.8%). The 2010 NFE weir gate percent in criteria on sill events (37.1%) was also greater than 2009 (34.4%). Criteria were sacrificed at this entrance to maintain criteria at the south fish entrance (SFE) which is the most used entrance. Consequently, whenever an out of criteria event occurred (when there was significant water to maintain criteria) it could most often be attributed to the system trying to maintain the minimum 8 feet of gate depth at the SFE.

North Shore Entrance (NSE): The 2010 NSE weir gate percent in criteria $\geq$ 8 feet (86.0%) was greater than 2009 (50.0%). The 2010 NSE weir gate percent in criteria on sill events (35.4%) was also greater than 2009 (31.3%). These out of criteria conditions are due to the inability to lower the entrance weir to 8 feet depth while maintaining the channel/tailwater differential.

Fish Collection Channel/Tailwater Head Differential: The channel/tailwater head differential was in criteria on most inspections in 2010 (criteria = 1 - 2 feet). The percent in criteria at the SFE, NFE, and NSE was 93.8%, 98.9%, and 78.7% respectively.

| ICE HARBOR<br>Criteria and Locations | No. in Criteria/ No. on Sill/ No. of Inspections | % In Criteria/ % On Sill | No./% Within 0.01-0.1 Foot | ----------Not Enough Depth---------- No./% Within 0.11-0.2 Foot | No./% >0.2 Foot | No./% Within 0.01-0.1 Foot | ----------Too Much Depth--------- No./% Within 0.11-0.2 Foot | No./% >0.2 Foot |
|---|---|---|---|---|---|---|---|---|
| **Channel Velocities** | 129 | 99.2 | *** | *** | *** | *** | *** | *** |
| | *** | *** | *** | *** | *** | *** | *** | *** |
| | 130 | | | | | | | |
| **Differentials** | | | | | | | | |
| **South Fish Ladder** | | | | | | | | |
| Ladder Exit | 178 | 100.0 | *** | *** | *** | 0 | 0 | 0 |
| | *** | *** | *** | *** | *** | 0.0 | 0.0 | 0.0 |
| | 178 | | | | | | | |
| Ladder Weirs | 165 | 92.7 | 6 | 2 | 1 | 4 | 0 | 0 |
| | *** | *** | 3.4 | 1.1 | 0.6 | 2.2 | 0.0 | 0.0 |
| | 178 | | | | | | | |
| Counting Station | 137 | 97.9 | *** | *** | *** | 1 | 1 | 1 |
| | *** | *** | *** | *** | *** | 0.7 | 0.7 | 0.7 |
| | 140 | | | | | | | |
| **North Fish Ladder** | | | | | | | | |
| Ladder Exit | 177 | 100.0 | *** | *** | *** | 0 | 0 | 0 |
| | *** | *** | *** | *** | *** | 0.0 | 0.0 | 0.0 |
| | 177 | | | | | | | |
| Ladder Weirs | 177 | 100.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *** | *** | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 177 | | | | | | | |
| Counting Station | 160 | 100.0 | *** | *** | *** | 0 | 0 | 0 |
| | *** | *** | *** | *** | *** | 0.0 | 0.0 | 0.0 |
| | 160 | | | | | | | |
| **Collection Channels** | | | | | | | | |
| South Shore | 167 | 93.8 | 0 | 0 | 2 | 3 | 5 | 1 |
| | *** | *** | 0.0 | 0.0 | 1.1 | 1.7 | 2.8 | 0.6 |
| | 178 | | | | | | | |
| North Powerhouse | 176 | 98.9 | 0 | 0 | 2 | 0 | 0 | 0 |
| | *** | *** | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 |
| | 178 | | | | | | | |
| North Shore | 140 | 78.7 | 0 | 1 | 1 | 0 | 7 | 26 |
| | *** | *** | 0.0 | 0.6 | 0.6 | 0.0 | 3.9 | 14.6 |
| | 178 | | | | | | | |
| **Weir Depths** | | | | | | | | |
| SFE 1 | 78 | 43.8 | 0 | 5 | 23 | *** | *** | *** |
| | 67 | 37.6 | 0.0 | 2.8 | 12.9 | *** | *** | *** |
| | 178 | | | | | | | |
| NFE 2 | 73 | 41.0 | 6 | 6 | 22 | *** | *** | *** |
| | 66 | 37.1 | 3.4 | 3.4 | 12.4 | *** | *** | *** |
| | 178 | | | | | | | |
| NSE 1 | 63 | 35.4 | 2 | 6 | 13 | *** | *** | *** |
| | 90 | 50.6 | 1.1 | 3.4 | 7.3 | *** | *** | *** |
| | 178 | | | | | | | |

*Data from Appendix 2.

## Recommendations

1. Continue to repair south ladder mud valves in the entrance channel and auxiliary water supply conduit to facilitate dewatering.
2. Modify the top of the downstream navigation lock gate so it will not strand fish.
3. Rehabilitate fish entrance weirs and hoisting equipment.
4. Relocate staff gages and radar units so the staff gage fishway control system reading and the automated fishway control system readings will be closer to the same depth.
5. Initiate a contract to repair leaks and missing concrete areas in the fish ladders.
6. Install a handrail along the outside edge of north and south fish ladders.
7. Replace the north and south fishway exit wooden log booms.
8. Replace adult fishways and adult collection channel grating.

# JUVENILE FISH PASSAGE FACILITY

## Facility Description

The juvenile fish passage facility at Ice Harbor Dam consists of standard length submersible traveling screens (STS's), vertical barrier screens (VBS's), 12 inch orifices (36 orifices), a collection channel and dewatering structure, fish sampling facilities, evaluation separator facilities, and a transportation flume/pipe to the tailrace downstream from the Project.

The fish collection channel has about 300 cfs flow and was operated with 20 orifices open. All but 30 cfs flow is removed at the primary dewatering structure. The remaining 30 cfs flow and fish are routed through a transport pipe and flume to the fish sampling facility or to the tailwater.

## Facility Modifications

The temporary high velocity separator facility was removed during the winter maintenance period. An anesthetic recirculation system was installed for use when sampling juvenile fish.

## Operations and Maintenance

Bypass Operations

Bypass operations began March 8, 2010 and continued through December 20, 2010.

Turbine Operations

Efforts were made to operate all turbine units within one percent of the best efficiency from March 15 to November 30. Deviations occurred but were infrequent and brief.

Debris/Trash Racks

Trash racks were raked March 1 - 5. Approximately 10 cubic yards of debris were removed. Turbine units 1 and 2 trash racks held the most debris. No additional trash rack raking was required during the season.

Submersible Traveling Screens

The STS' were installed March 16 and 17. STSs were inspected monthly beginning May 4th and ending November 17. One problem was found with the STS screens this season. On June 12 at 1357 turbine unit 2-B's STS screen was pulled for replacement of a failed motor. It returned to service later that day at 1653. No other problems were found during this season's STS inspections. Turbine units STS were raised December 14 – 16.

Vertical Barrier Screens

Project personnel inspected the vertical barrier screens (VBS's) while conducting STS inspections. Each VBS was inspected independently once each month during STS inspections. No problems were found with the VBS screens this season.

Gatewells

Gatewell debris was moderate at Ice Harbor Dam in 2010 and never approached the 50% coverage criteria point for mandatory cleaning. Slots were dipped for debris removal prior to installing STS screens and did not require additional attention. The total volume of debris removed for the season was less than 5 cubic yards.

Orifices/Collection Channel

During the 2010 season, the collection channel was operated with 20 open orifices. Orifices were routinely cycled and back flushed by powerhouse operators and fish facility personnel. During periods of higher fish and debris loads (April 1 through July 31), the orifices were back flushed and cycled once per shift. Orifice lights were checked daily and replaced when required. No problems to fish were experienced.

Primary Dewatering Structure

The primary dewatering screen cleaner brush had several failures this season. The Project replaced the cable and tray system during 2009 winter maintenance period. This system functioned well throughout 2010. We are still experiencing problems with the cable travel system that moves the screen cleaner up and downstream. The cable becomes frayed and needs to be replaced several times throughout the season.

Sampling System

Juvenile fish sampling occurred Mondays and Thursdays April 06 – July 1. The sampling system functioned well this season. No problems were associated with sampling. An anesthetic recirculation system was installed during the winter maintenance period.

Avian Predation

Avian predation on juvenile salmon and steelhead were observed at Ice Harbor Dam in 2010. Fish eating birds observed included: Cormorant, Gull, Blue Heron, White Pelican, Bald Eagle, Tern, Grebe, Kingfisher, Mergansers and Osprey.

Several actions have been taken to reduce predation. Bird wires are installed over the tailrace area below the powerhouse. These wires have been very effective. Needle strips (Nixalite) and other deterrent devices are installed around the Project to prevent birds from perching. A water cannon is affixed to the juvenile fish outfall pipe to discourage birds from holding in the bypass discharge area.

In addition to these measures, the Corps has contracted for the services of an animal control specialist from the United States Department of Agriculture's Animal and Plant Health Inspection Service (APHIS). The animal control specialist hazed birds by using pyrotechnics. Hazing took place in three locations: tailrace near bird wires, tailrace downstream of bird wires to the power line crossing, and forebay near the entrance to the juvenile bypass.

## Recommendations

1. Install a water line in the primary dewaterer to provide flush water to the transportation flume.

2. Modify the juvenile collection channel to allow fish that are handled during dewatering to be put into the bypass pipe and returned to the river.

3. Pave the road and provide curbing that would direct any water runoff away from the juvenile facility and the hillside.

4. Install a hopper in the main bypass pipe below the sampling stations. This would permit
unwatering event rescued fish to be returned to the tailrace via the bypass pipe.

5. Install a crowding mechanism in the juvenile collection channel that would encourage adult fish to exit.

6. Replace the outfall pipe water cannon black iron pipe with stainless steel to prevent corrosion. In addition, replace the pump and water gun.

7. Install handrail along the north and south adult fishway ladders.

8. Install a debris bubbler system under the entire incline screen located in the juvenile fish collection channel.