
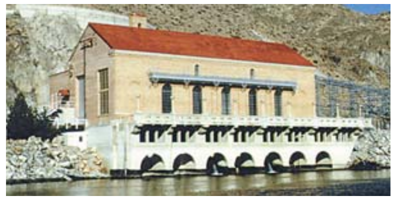


PUBLIC UTILITY DISTRICT NO. 1 *of* CHELAN COUNTY
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February 19, 2009

Pat Irle, Hydropower Projects Manager
Dept. of Ecology, CRO
Water Quality Program
15 W Yakima Ave, Suite 200
Yakima, WA 98902-3452

Re: Rocky Reach and Rock Island Hydroelectric Projects Nos. 2145 and 943 2009 Gas Abatement Plans

Dear Ms. Irle:

Please find enclosed Chelan County Public Utility District's (Chelan PUD) 2009 Gas Abatement Plans (GAPs) for Rocky Reach and Rock Island Hydroelectric Projects.

These GAPs are being submitted to Washington State Department of Ecology as a condition of the 2006 Special Fish Passage Exemption (WAC 173-201A-200(1)(f)). Chelan PUD respectfully submits these plans with the goal of receiving a waiver commencing with the 2009 fish spill season.

Please feel free to call or email me if you have any questions or need further information.

Thank you,

Waikele (Kelee) Hampton
Environmental Permit Coordinator
Chelan County PUD
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TOTAL DISSOLVED GAS ABATEMENT PLAN
ROCK ISLAND HYDROELECTRIC PROJECT

February 2009

Prepared by:

Waikele Hampton
Public Utility District No. 1 of Chelan County
Wenatchee, WA 98801

Prepared for:

Washington Department of Ecology
Yakima, Washington 98902-3452

1. INTRODUCTION

This Gas Abatement Plan (GAP) is being submitted to Washington State Department of Ecology as a condition of the 2006 Special Fish Passage Exemption (WAC 173-201A-200(1)(f)). Chelan County Public Utility District (Chelan PUD) respectfully submits this plan with the goal of receiving a waiver commencing with the 2009 fish spill season.

1.1 Total Dissolved Gas

Research has shown that releasing water through spillways is a safe and effective means of passing downstream migrating salmonids past some hydroelectric projects. However, monitoring has shown that in doing so there may be adverse effects to water quality, specifically supersaturation of river water with atmospheric gases. The spilled water carries atmospheric gases to the depths of the river where increased hydrostatic pressure supersaturates the water with those gases.

Many variables contribute to the saturation levels of TDG, including, but not limited to, existing forebay gas concentrations, spill flow rates, tailwater depths, air entrainment, spill plunge depths, entrainment flows, and temperature of the water.

1.1.1 Total Dissolved Gas and Impacts to Aquatic Life

A potential consequence of total dissolved gas (TDG) supersaturation to fish and other aquatic species is a condition known as gas bubble trauma (GBT) (Jensen et al., 1986). GBT is a physically induced condition caused by pressure dis-equilibrium between liquid and gas phases (Jensen et al., 1986), which can result in tissue lesions (i.e., blood emboli and emphysema of fish), causing physiological dysfunction (Bouck, 1980). Although it has been shown that TDG levels of 110% can result in GBT when fish are held in shallow water, there is little evidence that TDG levels of 110% are detrimental to juvenile salmonids migrating through the mainstem of the Columbia River (Meekin and Turner 1974, Bouck et al., 1976; Weitkamp and Katz, 1980 and Bernard, 1993). The severity of GBT is related to the degree of TDG saturation relative to the depth where fish reside and the exposure time at a given concentration.

1.1.2 Washington State Numeric Water Quality Criteria

The Washington State water quality numeric criterion states TDG measurements shall not exceed 110 percent at any point of measurement in any state water body. However, WAC 173-201A-200(1)(f)(ii) provides a special fish passage criteria for TDG to aid fish passage over hydroelectric dams when consistent with a WDOE approved gas abatement plan:

> *"The TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with a department approved gas abatement plan. This plan must be accompanied by fisheries management and physical and biological monitoring plans. The elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:*
>
> > *1. TDG must not exceed an average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one*

hundred twenty percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure); and

2. A maximum TDG one hour average of one hundred twenty-five percent must not be exceeded during spillage for fish passage."

1.2 Habitat Conservation Plan

More than fifteen years ago, Chelan PUD began to assess how it should respond to a changing regulatory environment that was increasingly affecting operation of Rocky Reach and Rock Island Hydroelectric Projects on the Columbia River. Chelan PUD has since developed two Habitat Conservation Plans (HCP) for anadromous fish in cooperation with federal and state regulatory agencies and Tribes. The HCPs were developed to conserve and protect all anadromous fish species over the long term, and to support ongoing compliance with the ESA while allowing continued operation of the Project. All measures proposed in the HCPs are intended to minimize and mitigate impacts to the Plan species, to the "maximum extent practicable" as required by the Endangered Species Act. Measures that promote fish passage survivability include spills and modified spills that generate TDG during the outmigration of juvenile fish. The plans commit Chelan PUD to a 50-year program to ensure our hydro projects have "no-net-impact" on mid-Columbia salmon and steelhead runs.

The HCPs began by implementing the "Phase I Plan to Achieve the Performance Standards". Assessment (survival) studies have been conducted over the last three years to determine the survival rates of plan species. For the studies to be considered valid, the studies needed to take place during average flow conditions and normal project operating conditions consistent with the approved study design. This means project operations; including spill levels and configurations, as well as the overall project structure (such as spillway structures), need to remain constant during the survival studies. If Chelan PUD finds feasible gas abatement methods during these studies, implementation of those methods will be considered following Phase I.

2. GOAL AND OBJECTIVES

The purpose of this TDG Abatement Plan is to outline the long-term plan for enhancing water quality at the Public Utility District No. 1 of Chelan County's (District) Rock Island Hydroelectric Project. This plan will identify Chelan PUD's steps to meet the Washington Department of Ecology's (DOE) TDG requirements at the project.

The initial goal of this schedule is to identify measures that will aid Chelan PUD in improving water quality. However, Chelan PUD's long-term goal is to choose reasonable and feasible measures that do not conflict with other natural resource protection goals (i.e. anadromous fish passage) and have a measurable biological benefit.

Flexibility will be necessary in this schedule due to unknown factors, including levels of success of Habitat Conservation Plan survival studies and river conditions.

This Gas Abatement Plan summarizes the Rock Island Project, associated facilities and water management, discusses Rock Island Project spill scenarios and defines the measures associated with Chelan PUD's monitoring program during spill operations in support of juvenile fish passage, and provides a summary of past TDG activities and a future schedule of Rock Island Project TDG compliance activities.

3. ROCK ISLAND PROJECT

3.1 Project Description

Rock Island Dam is owned and operated by Chelan County Public Utility District No. 1. The structure is 3,800 ft. in length and is constructed from reinforced concrete. The dam is located at Columbia River mile 453.4, about 12 miles downstream from the city of Wenatchee. The project contains a reservoir extending 21 miles up river to the tailrace of Rocky Reach Dam and covers 3,300 acres. The Rock Island Project has no significant water storage capabilities. The pond contains about 7,500 acre-feet of usable storage with a four-foot drawdown and a minimum operating pool at elevation 609 ft. (USGS) above sea level. The dam deck is at 616.02 ft. (USGS). Average headwater elevation for the project is 614.1 ft. (USGS), and the average tailwater elevation is 572 ft. (USGS). The project discharges into a reservoir ponded by Wanapum Dam located 37.6 miles downstream.

The project consists of two powerhouses. Powerhouse 1 is located on the east bank of the project at a 45-degree angle from the bank. The powerhouse consists of 10 vertical shaft turbines with a rated output of 212 MW. Powerhouse 2 is located on the west bank and is 470 ft. wide, housing eight horizontal shaft turbines with a rated power output of 410 MW. The combined hydraulic capacity of both powerhouses is 220 kcfs.

The project configuration includes a spillway of 32 bays with a total length of 1,184 ft. Gates are separated by a middle fish ladder (located at bay 15) that divides the spillway into east and west sections. The west (Chelan County side) spillway consists of seven deep bays and ten shallow bays, and the east (Douglas County side) spillway consists of six deep bays and eight shallow bays. Each spillway has two or three crest gates, which are stacked one on top of the other. The crest gates are 30 ft. wide and either 11 or 22 ft. high. The larger crest gates are positioned closest to the water surface, and when fully raised, spill approximately 10 kcfs.

The deep bays have a sill elevation of 559-ft. (USGS), which is about 13 ft. below the average tailwater elevation of 572 ft. (USGS). The shallow bays have a sill elevation of 581.5 ft. (USGS), which is about 9.5 ft. above the average tailwater elevation.

The focus of juvenile fish bypass at Rock Island Dam has been directed towards optimizing the efficiency of fish passage via spill. To achieve this, nine of the thirty-two spill bays have had their spill gates modified to provide surface spill. Surface spill was accomplished by putting notches in the upper sections of the spill gates. Six of the nine gates have notches that are 8 feet wide by 17 feet deep and can spill up to 2,500 cfs. The remaining gates have notches that are smaller and pass less volume (approximately 1,850 cfs). The total amount of water that can be passed through the notched gates is approximately 21,000 cfs. Three of the modified gates have had further modification and now have a “over-under” design which enables surface flow attraction and delivers water in the tailrace towards the surface, thus reducing the uptake of atmospheric gases.

3.2 Runoff and Coordination

The climate of the Columbia Basin in eastern Oregon, Washington and British Columbia is best described as desert. The major portion of the precipitation experienced within the basin falls in the form of snow during the period of November through March of each year. Runoff usually occurs from mid-April through July, with the historical peak occurring during the month of June. Storage dams in the U.S. and Canada capture spring and summer high flows to hold for release in the winter months.

In general, the hydropower system and reservoir operations in the Columbia River are coordinated through a set of complex agreements and policies to optimize the benefits and minimize the adverse effects of project operations, including the Mid-Columbia Hourly Coordination Agreement (Hourly Coordination).

Hourly Coordination operates the seven dams from Grand Coulee through the Priest Rapids Dam to meet system load requests while minimizing the reductions in head that could result if the projects independently used active storage in their reservoirs to meet individual loads. Efficient load following is accomplished by matching load requests to the movement of water released from Grand Coulee as it passes sequentially through the downstream projects, while maintaining the forebays of these projects as near full as possible. Limitations to operations flexibility at any of the projects with active storage result in greater fluctuations in discharge and forebay elevation at the remaining coordinated projects. The Rock Island Project has very little active storage capability and therefore is rarely used in Hourly Coordination to shape system loads.

4. HISTORY OF OPERATIONS AND COMPLIANCE

The passage and protection of migrating juvenile fish is provided at many dams with high levels of spill. At most projects, this route is preferred for safe passage and research indicates that survival of migrating juvenile salmonids is greatly enhanced via spill passage routes (NMFS 2000). At Rock Island Dam, TDG monitoring during fish passage spill has occurred since 1996.

4.1 Spill Scenarios

The six main scenarios that could result in spill at Rock Island Dam are, but are not limited to:

- fish bypass spill
- flow in excess of hydraulic capacity
- powerplant load rejection spill
- immediate replacement spill
- maintenance spill
- error in communication with Corps reservoir

It is recognized that achieving regulatory TDG levels may not be possible during spill associated with large flood (7Q10) events. However, at Rock Island Dam it may be possible to achieve current regulatory TDG levels during releases for fish bypass and up to the 7Q10 flows (264 kcfs) by selective operation of spillway bays. The Rock Island Project is unique due to the diversity of variations in how flow is released, which may assist in the development of spill scenarios that could result in a reduction of gas in the tailrace.

4.1.1 Fish Bypass Spill

In accordance with the Rock Island HCP, spill is currently the primary method for fish bypass at Rock Island Dam. This document provides for spring spill and summer spill. The spring spill covers the out-migration period of spring chinook and steelhead smolts, and typically begins in mid-April and ends in June of each year. The summer spill covers the out-migration of summer chinook and typically begins in late June to early July and ends no later than August 31 of each year. For more detail regarding fish spill, please see Section 4.1 above.

4.1.2 Flow in Excess of Hydraulic Capacity

The limited hydraulic capacity and minimal storage capacity of the project occasionally force Chelan PUD to spill water past the project. This spill is required to maintain headwater elevations within the limits set by the Federal Energy Regulatory Commission license, to prevent overtopping of the project, and to maintain optimum operational conditions. With this type of spill release the 7Q10 flood flows (264 kcfs) are also accommodated.

4.1.3 Plant Load Rejection Spill

This type of spill occurs when a plant is forced off line by an electrical fault, which trips breakers, or any other activity forcing the units off line. When the units cannot process flow, the flow must be passed by other means to avoid overtopping the dam, which usually requires emergency spill through the use of auto hoists.

Chelan PUD will immediately implement the Operational Spill Management Plan to address this emergency situation. It is expected that this will be addressed operationally, which requires no structural modifications.

4.1.4 Immediate Replacement Spill

Immediate replacement spill is used to manage TDG levels throughout the Columbia River basin. This spill is implemented and managed by the Technical Management Team (including National Marine Fisheries Service (NMFS), US Army Corps of Engineers (USACE), and Bonneville Power Administration (BPA)). Immediate replacement spill occurs when TDG levels are significantly higher in one river reach than they are in another. To balance the TDG levels throughout the basin, spill is reduced and generation increased in the reach with high TDG levels and the energy is transferred to reaches with lower TDG levels where spill is increased. The result is higher generation in the reaches with high TDG levels, increased spill in reaches with lower TDG levels, and equal distribution of TDG levels throughout the basin.

To control TDG levels that may result from immediate replacement spill, Chelan PUD has completed and implemented a TDG Operational Plan. It is expected that this will be addressed operationally, requiring no structural modifications.

4.1.5 Maintenance Spill

Maintenance spill is utilized for any maintenance activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include forebay debris flushing, checking gate operation, gate maintenance, and all other maintenance that would require spill. The Federal Energy Regulatory Commission requires that all spillway gates be operated once per year. This operation requires a minimal amount of spill for a short duration annually, and is generally accomplished in conjunction with fish passage spill operations.

Chelan PUD has completed and will implement an TDG Operational Plan to address potentially elevated TDG levels that may result from this form of spill. It is expected that this will be addressed operationally, requiring no structural modifications.

4.1.6 Error in Communication Spill

This type of spill is caused by error in communication with The U.S. Army Corps Reservoir Control Center, including computer malfunctions or human error in transmitting data. Hourly coordination between hydroelectric projects on the river minimizes this type of spill, which does occur occasionally.

To address potentially elevated TDG levels that may result from this form of spill, Chelan PUD has completed and will implement a TDG Operational Plan and will maintain hourly coordination. This will be addressed operationally, requiring no structural modifications.

4.2 Compliance Activities in 2004-2008

4.2.1 TMDL Activities

The Summary Implementation Strategy (SIS) for the Mid-Columbia TDG TMDL outlined short-term implementation actions that each project had previously initiated, or was to initiate by 2006. The actions identified for Rock Island included the completion of a literature review and investigations into additional submerged spill bays (over/under gates), both of which Chelan PUD has either begun or completed. In addition, Chelan PUD, in partnership with the other Mid-C PUDs, funded a consultant to compile a document reviewing TDG literature from 1980-2007. This document has been completed and was presented to the Adaptive Management Team in 2008.

4.2.2 Over/Under Gate Installation

In 2004 Chelan PUD determined that an Over/Under prototype gate structure was a potential gas reducing structure and approved the modeling, design, installation, and testing of one prototype. Chelan PUD modeled, designed, installed, and tested a single bay Over/Under prototype gate between 2004 and 2006. The test results indicated that the prototype was capable of reducing TDG uptake by 8.5 to 13.5 % points, as compared to the existing notched gate method, and by an additional 2.5 to 4.5 % points as compared to deflector prototypes. The fish passage survival tests performed indicates that overall survival was 100% and 99.1% through the gate system in the aerated and non-aerated configurations, respectively. As a result of the success of the Over/Under gates during prototype testing, Chelan PUD made the decision to have three in place prior to the initiation of the 2007 spill season.

This spill configuration employs a spillway with both an upstream gate and a downstream gate. The upstream overflow spill gate is opened at the surface for the purpose of attracting fish. The downstream gate is lifted from the bottom, resulting in submerged spill, which the 1999 WES study showed eliminated gas entrainment since no air could mix with spillway flows. The desired outcome of this configuration is to achieve a high level of fish passage and survival through the overflow gate while maintaining a submerged spill condition under the downstream gate.

4.2.3 Reductions in Spill
Operating under a spill regime of 20% of the daily average river flow, the survival standards for spring plan species have been met at Rock Island. Due to the success of the survival studies thus far, Chelan PUD began testing powerhouse optimization in 2007, resulting in spring voluntary spill being reduced to 10% of the daily average river flow. Chelan PUD will continue to test this spill scenario in the 2009 spill season. Summer spill remains at 20% of the daily average river flow.

4.2.4. Potential Operational Changes
Potential operational changes that have been identified to date that are available at the project to meet state water quality standards and the required HCP spill to meet fish survival standards are:

1) changes to spill configurations (moving some spill from deep spill bays to shallow bays, flattening out spill to more level volumes over the entire day instead of peaks and valleys, sending a portion of spill through submerged gates instead of full gates)
2) powerhouse operations
3) revise the operations protocol to be used when conditions of non-compliance may occur

5. PROPOSED OPERATIONS AND ACTIVITIES

5.1 Operational Spill Plan

Fish spill operations in 2009 at Rock Island will be implemented by Chelan PUD according to certain juvenile survival standards that have been achieved by Chelan PUD and some that have yet to be achieved.

Rock Island 2009 Spring Spill
In 2009, under Section 5.3.3 of the Rock Island HCP, Chelan PUD will re-evaluate Project Survival for yearling Chinook (as a representative spring species) under a 10% spill level. The 10% spill level will begin no later than April 17, and end on approximately June 1, following completion of the 10% spring spill study. The Rock Island bypass trap will be operated seven days per week by WDFW personnel to provide daily juvenile index counts. The trap will operate from April 1 through August 31. Index counts will provide the basis for comparison to determine the start and end of seasonal spill periods. Guidelines to start and end the spring spill program at Rock Island are proposed as follows:

1. The Rock Island spring spill program will begin when the Rock Island daily passage index (expanded counts) exceeds 400 fish for more than 3 days (this corresponds to the historic 5% passage date), or no later than April 17, as outlined in Section 5.4.1. (a) of the HCP. Wenatchee River smolt trap counts (at Monitor) will be used to help validate a decision to start spring spill prior to April 17.

2. The Rock Island spring spill will likely end in the first week of June, unless the 2009 yearling Chinook, steelhead, and sockeye survival studies have not yet been completed.

Rock Island 2009 Summer Spill

Rock Island will spill 20% of the daily average river flow over 95% of the summer out migration. Daily sub-yearling Chinook samples at the bypass trap will provide the basis for decisions to the start and stop spill periods at Rock Island Dam. The proposed guidelines to start and stop the summer spill at Rock Island are outlined as follows:

1. Rock Island summer spill will likely begin in the first week of June, after completion of the spring survival study. The summer spill level will be 20% and continue for a duration covering 95 percent of the subyearling outmigration.

2. Spill will likely end no later than August 15^{th}, or when subyearling counts from the Rock Island trap are 0.3% or less of the cumulative run total for any three out of five consecutive days (same protocol used in 2005-08).

All spill for fish passage will come from notched gates in bays 1, 16, 18, 30, 31, 32, 24, 26, and 29. If the spill through the aforementioned bays is insufficient to meet daily estimated flow (DEF), or hydraulic capacity is exceeded, full gates in bays 20, 19, 25, 17, 22, and 21 (in that order) are to be pulled. If it is necessary to spill a larger volume of water then the above gates provide; gates are pulled in the order necessary to maintain plant safety.

Spill not provided for juvenile passage will be shaped to avoid delay of upstream migrants according to agreements made within the HCP Coordinating Committee and will be shaped to follow the diel distribution of the fish present.

5.2 TDG Monitoring Program

As required by issuance of a TDG exemption for the Rock Island Project, Chelan PUD will continue to implement a physical and biological monitoring program at Rock Island Dam during the juvenile fish migration season. Activities include fisheries management activities, participation in water quality forums, collection of TDG data during the migration season, and collection of biological monitoring data.

5.2.1 Fisheries Management Activities

Chelan PUD shall continue to operate the Rock Island adult fishways and manage spill in accordance with HCP operations criteria to protect aquatic life designated uses.

Juvenile

At Rock Island, downstream migrant passage facilities are incorporated in the second powerhouse and right bank fishway. The downstream migrant facilities consist of two separate bypass systems that fish enter volitionally. Both systems combine to utilize a common 36-inch discharge pipeline. The intake gatewell system (GWS) consists of a series of ports at the second powerhouse intake gate slots and a fingerling bypass channel that extends along the upstream face of the powerhouse structure. The traveling water screen bypass (TWSB) consists of a series of ports and vertical riser pipes. The traveling water screens are located adjacent to the right bank fishway exit. Incorporated in the bypass pipeline is a fish trapping facility for the collection and examination of downstream migrants.

The Rock Island bypass trap will be operated seven days per week April 1 – August 31 by WDFW personnel to provide daily juvenile index counts. Index counts will provide the basis for comparison to determine the start and end of seasonal spill periods.

Adult

Rock Island Dam is equipped with three fishways, one at each powerhouse and one that divides the spillway in half. All three fishways consist of entrances with attraction water systems, a pool and ladder section, flow regulation weirs, and a fish counting station. The left bank fishway (powerhouse 1) has two vertical slot entrances located at the shoreline and a gravity attraction water system. The center fishway (spillway) has a gravity attraction water system, a main vertical slot entrance that discharges perpendicular to the spillway, and a small vertical slot entrance that discharges parallel with spillway flow just downstream of the spillway stilling basin. The right fishway (powerhouse 2) has four vertical slot entrances; one at the north end of the powerhouse, two at the shoreline corner (south end of the powerhouse) and a tailrace entrance that is located downstream of the powerhouse. The attraction water in the right fishway is provided by a combination of gravity and three motor-operated attraction water pumps. Lights have been installed from the counting window to the fishway exit to improve fish passage through this section of the upper fishway.

For the purpose of operation and maintenance, primary fish passage is considered to occur from March through November of each year. Adult facilities will be open from March 1 to December 1 each year.

5.2.2 Water Quality Forums

Chelan PUD regularly participates in the Regional Water Quality Team and Transboundary Gas Group.

5.2.3 Physical Monitoring

Chelan PUD will maintain two fixed monitoring stations at the dam to monitor TDG levels annually from April through August, one in the forebay and one in the tailrace at the approved monitoring sites.

TDG measurements will be recorded throughout the monitoring season at 15-minute intervals, enabling plant operators to adjust spill volumes to maintain gas levels to prevent exceedances of the TDG criteria. These 15-minute intervals will be averaged into hourly readings for use in compiling daily and 12-hour averages. All hourly data will be forwarded to District headquarters building and then onto the US Army Corps of Engineers Reservoir Control Center and posted at their site on the World Wide Web.

Chelan PUD will enter into a Professional Services Agreement with Columbia Basin Environmental (CBE) to perform monthly calibrations and equipment maintenance during the 2008 monitoring season. It is anticipated at this time that Chelan PUD will continue to contract with CBE into the future. QA/QC measures will be accomplished through training in instrument maintenance, operation, and factory prescribed calibration methods. A detailed log will be maintained for all work done on the monitoring equipment, including monthly maintenance, calibration, exchange of instruments, and any other pertinent information. Redundant measurements with a mobile instrument to verify the accuracy of the in-situ instruments will be conducted during the monthly calibrations.

5.2.4 Biological Monitoring

The WDFW, in conjunction with the FPC, conducts gas bubble trauma (GBT) monitoring at the Rock Island Bypass Trap. Random samples of 100 spring chinook, steelhead and subyearling chinook are examined two days per week during the sampling season (April 1st to August 31st). Examinations for GBT symptoms follow a standardized FPC protocol. The results of each examination are transmitted to the FPC. A year-end report is prepared by the WDFW summarizing the results of the sampling season.

5.3 Compliance Activities for 2009-2010

5.3.1 Powerhouse Optimization Studies

Chelan PUD will continue powerhouse optimization studies, thereby reducing voluntary spill volumes. Because the project is operating under Phase I of the HCP, which requires survival studies be conducted during representative flow conditions and normal project operating conditions consistent with the approved study design, no significant changes have been can be made to operations until the end of the Phase 1. The actual year in which changes can be made is dependent upon the success of Phase I. At the completion of Phase I Chelan PUD will know what levels of spill are necessary to ensure the survival goal is met. It is at this time Chelan PUD may be able to determine what gas abatement measures are feasible and necessary to meet water quality requirements and HCP survival standards.

5.3.2 Over/Under Spill Gate Operation

Chelan PUD intends to utilize the Over/Under spill gates through at least 2012. Before additional Over/Under gates are constructed, or other structural changes are made, Chelan PUD will operate under the existing structural configuration over the course of the next several years to determine the impact on TDG abatement resulting from the three existing Over/Under gates.

5.4 Additional Requirements

Chelan PUD will operate the Project in accordance with the following:

1. <u>7Q10</u>. The 7Q10 for Rock Island is 264 kcfs. The Project will not be expected to comply with state water quality standards for TDG for incoming flows exceeding this value.

2. Fish Spill. For the purposes of compliance, the "fish spill" season is taken to occur from April 1 – August 31; and "non-fish spill" season occurs from September 1 to March 31, unless otherwise specified in writing by Ecology.

3. Compliance During Non-Fish Spill. During non-fish spill, Chelan PUD will make every effort to remain in compliance with the 110% standard.

4. Compliance During Fish Spill. During fish spill, Chelan PUD will make every effort not to exceed an average of 120% as measured in the tailrace of the dam. The Project also must not exceed an average of 115% as measured in the forebay of the next downstream dam. These averages are based on the twelve (12) highest consecutive hourly readings in any 24-hour period. In addition, there is a maximum one-hour average of 125%, relative to atmospheric pressure, during spillage for fish passage. Nothing in these special conditions allows an impact to existing and characteristic uses.

5. TDG Monitoring. Chelan PUD will maintain two fixed monitoring stations at the dam to monitor TDG levels annually from April through August, one in the forebay and one in the tailrace at the approved monitoring sites. This information is available on a real time basis to all interested parties at the US Army Corps of Engineers website (http://www.nwd-wc.usace.army.mil/report/tdg.htm).

6. Reporting Spill for Fish and TDG Exceedances. Chelan PUD will notify Ecology within 24 business hours of spill for fish and when TDG standards are exceeded. Reporting shall be electronically (via e-mail) to the hydropower project manager in Ecology's Central Region Office.

7. General TDG Abatement Measures. Chelan PUD will manage spill toward meeting water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards sets forth in the HCP and Fish Management Plans, as follows:

> a. Minimize voluntary spill,
> b. During fish passage, manage voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria,
> c. Minimize spill, to the extent possible, by scheduling maintenance based on predicted flows.

8. Annual TDG Monitoring Report. Chelan PUD shall submit an annual monitoring report. A draft monitoring report of the year's monitoring report shall be submitted to Ecology by October 31 of the monitoring year. Chelan PUD will submit the final report, incorporating Ecology's suggested corrections, by December 31 of the same year. The contents of the report shall include, at a minimum:

> a. Flow and TDG levels, on a daily basis, with purpose of spill (e.g. fish spill, turbine down time),
> b. Summary of exceedances and what was done to correct the exceedances,
> c. Results of the fish passage efficiency (FPE) studies and survival per the HCP

9. Revised Gas Abatement Plan (GAP). Chelan PUD will revise the GAP annually, to reflect any changes, and new or improved information and technologies. Chelan PUD will submit a draft to Ecology for review and approval by February 28 of the year of implementation. The GAP shall be in the format of Chelan PUD's 2009 GAP, unless modifications are requested by Ecology.

10. Ecology Contact. Chelan PUD will direct its correspondence to:

Pat Irle, Hydropower Projects Manager
Department of Ecology, Central Region Office
Water Quality Program
15 W. Yakima Ave., Suite 200
Yakima, WA 98902-3452

6. REVISIONS TO THE TAILRACE MONITORING PLAN

There are no revisions to the Rock Island tailrace monitoring plan anticipated at this time.

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TOTAL DISSOLVED GAS ABATEMENT PLAN
ROCKY REACH HYDROELECTRIC PROJECT

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1. INTRODUCTION

This Gas Abatement Plan (GAP) is being submitted to Washington State Department of Ecology as a condition of the 2006 Special Fish Passage Exemption (WAC 173-201A-200(1)(f)). Chelan County Public Utility District (Chelan PUD) respectfully submits this plan with the goal of receiving a waiver commencing with the 2009 fish spill season.

1.1 Total Dissolved Gas

Research has shown that releasing water through spillways is a safe and effective means of passing downstream migrating salmonids past some hydroelectric projects. However, monitoring has shown that in doing so there may be adverse effects to water quality, specifically supersaturation of river water with atmospheric gases. The spilled water carries atmospheric gases to the depths of the river where increased hydrostatic pressure supersaturates the water with those gases.

Many variables contribute to the saturation levels of TDG, including, but not limited to, existing forebay gas concentrations, spill flow rates, tailwater depths, air entrainment, spill plunge depths, entrainment flows, and temperature of the water.

1.1.1 Total Dissolved Gas and Impacts to Aquatic Life

A potential consequence of total dissolved gas (TDG) supersaturation to fish and other aquatic species is a condition known as gas bubble trauma (GBT) (Jensen et al., 1986). GBT is a physically induced condition caused by pressure dis-equilibrium between liquid and gas phases (Jensen et al., 1986), which can result in tissue lesions (i.e., blood emboli and emphysema of fish), causing physiological dysfunction (Bouck, 1980). Although it has been shown that TDG levels of 110% can result in GBT when fish are held in shallow water, there is little evidence that TDG levels of 110% are detrimental to juvenile salmonids migrating through the mainstem of the Columbia River (Meekin and Turner 1974, Bouck et al., 1976; Weitkamp and Katz, 1980 and Bernard, 1993). The severity of GBT is related to the degree of TDG saturation relative to the depth where fish reside and the exposure time at a given concentration.

1.1.2 Washington State Numeric Water Quality Criteria

The Washington State water quality numeric criterion states TDG measurements shall not exceed 110 percent at any point of measurement in any state water body. However, WAC 173-201A-200(1)(f)(ii) provides a special fish passage criteria for TDG to aid fish passage over hydroelectric dams when consistent with a WDOE approved gas abatement plan:

> *"The TDG criteria may be adjusted to aid fish passage over hydroelectric dams when consistent with a department approved gas abatement plan. This plan must be accompanied by fisheries management and physical and biological monitoring plans. The elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:*
>
> > *1. TDG must not exceed an average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one*

hundred twenty percent as measured in the tailraces of each dam (these averages are measured as an average of the twelve highest consecutive hourly readings in any one day, relative to atmospheric pressure); and

2. A maximum TDG one hour average of one hundred twenty-five percent must not be exceeded during spillage for fish passage."

1.2 Habitat Conservation Plan

More than fifteen years ago, Chelan PUD began to assess how it should respond to a changing regulatory environment that was increasingly affecting operation of Rocky Reach and Rock Island Hydroelectric Projects on the Columbia River. Chelan PUD has since developed two Habitat Conservation Plans (HCP) for anadromous fish in cooperation with federal and state regulatory agencies and Tribes. The HCPs were developed to conserve and protect all anadromous fish species over the long term, and to support ongoing compliance with the ESA while allowing continued operation of the Project. All measures proposed in the HCPs are intended to minimize and mitigate impacts to the Plan species, to the "maximum extent practicable" as required by the Endangered Species Act. Measures that promote fish passage survivability include spills and modified spills that generate TDG during the outmigration of juvenile fish. The plans commit Chelan PUD to a 50-year program to ensure our hydro projects have "no-net-impact" on mid-Columbia salmon and steelhead runs.

The HCPs began by implementing the "Phase I Plan to Achieve the Performance Standards". Assessment (survival) studies have been conducted over the last three years to determine the survival rates of plan species. For the studies to be considered valid, the studies needed to take place during average flow conditions and normal project operating conditions consistent with the approved study design. This means project operations; including spill levels and configurations, as well as the overall project structure (such as spillway structures), need to remain constant during the survival studies. If Chelan PUD finds feasible gas abatement methods during these studies, implementation of those methods will be considered following Phase I.

2. GOALS AND OBJECTIVES

The purpose of this TDG Abatement Plan is to outline the long-term plan for enhancing water quality at Rocky Reach Dam. This plan will identify Chelan PUD's steps to meet the state of Washington's Department of Ecology (DOE) TDG requirements at Rocky Reach.

The initial goal of this schedule is to identify measures that will aid Chelan PUD in improving water quality. However, Chelan PUD's long-term goal is to choose reasonable and feasible measures that do not conflict with other natural resource protection goals (i.e. anadromous fish passage) and have a measurable biological benefit.

Flexibility will be necessary in the following schedule due to unknown factors, including levels of success in the Project's permanent fish bypass system, success of Habitat Conservation Plan survival studies, and river conditions.

This Gas Abatement Plan summarizes the Rocky Reach Project, associated facilities and water management, discusses Rocky Reach Project spill scenarios and defines the measures associated with Chelan PUD's monitoring program during spill operations in support of juvenile fish passage, and provides a summary of past TDG activities and a future schedule of Rocky Reach Project TDG compliance activities.

3. ROCKY REACH PROJECT

3.1 Project Description

Rocky Reach Dam is owned and operated by Chelan County Public Utility District No. 1. The project is located on the Columbia River at river mile 474, about 7 miles upstream of the city of Wenatchee. Construction of the dam and powerhouse began in 1956 and the project was completed and put into production in 1961. The impounding structures are a mass of reinforced concrete consisting of a forebay wall section about 460 feet long, a combined intake and powerhouse section 1,088 feet long, a non-overflow center dam spillway that is 740 feet long consisting of 12 bays, each controlled by a 50 foot wide, 58 foot high radial gate. A 2,000-foot sub-surface cutoff consisting of a grout curtain and a compacted impervious barrier limits seepage through a terrace forming the east bank.

The forebay wall consists of mass concrete gravity blocks of various heights, with a maximum height of 118 feet. The service bay connects the forebay wall to the powerhouse. The powerhouse consists of 11 units, each 86 feet wide and approximately 200 feet long. The 11 turbines provide the total nameplate generating capacity of 1,213 MW and a total hydraulic capacity of 217.5 thousand cubic feet per second (kcfs).

A permanent bypass system was installed at the Project from September 2002 to March 2003, and has been in operation since then. The system consists of a surface collection system and a bypass conduit to provide downstream passage to juvenile salmon and steelhead.

3.2 Runoff and Coordination

The climate of the Columbia Basin in eastern Oregon, Washington and British Columbia is best described as desert. The major portion of the precipitation experienced within the basin falls in the form of snow during the period of November through March of each year. Runoff usually occurs from mid-April through July, with the historical peak occurring during the month of June. Storage dams in the U.S. and Canada capture spring and summer high flows to hold for release in the winter months.

In general, the hydropower system and reservoir operations in the Columbia River are coordinated through a set of complex agreements and policies to optimize the benefits and minimize the adverse effects of project operations, including the Mid-Columbia Hourly Coordination Agreement (Hourly Coordination).

The Rocky Reach Project is a participant in the Mid-Columbia Hourly Coordination Agreement (Hourly Coordination). Hourly Coordination operates the seven dams from Grand Coulee through the Priest Rapids Dam to meet system load requests while minimizing the reductions in head that could result if the projects independently used active storage in their reservoirs to meet individual loads. Efficient load following is accomplished by matching load requests to the movement of water released from Grand Coulee as it passes sequentially through the downstream projects, while maintaining the forebays of these projects as near full as possible. Limitations to operations flexibility at any of the projects with active storage result in greater fluctuations in discharge and forebay elevation at the remaining coordinated projects.

4. HISTORY OF OPERATIONS AND COMPLIANCE

The passage and protection of migrating juvenile fish is provided at many dams with high levels of spill. At most projects, this route is preferred for safe passage and research indicates that survival of migrating juvenile salmonids is greatly enhanced via spill passage routes (NMFS 2000). However, at Rocky Reach Dam the juvenile fish bypass system is the preferred method of juvenile fish passage, and spill is utilized as a supplemental method for fish bypass. At Rocky Reach Dam, TDG monitoring during fish passage spill has occurred since 1996.

4.1 Spill Scenarios

The six main scenarios that could result in spill at Rocky Reach Dam are, but are not limited to:

- fish bypass spill
- flow in excess of hydraulic capacity
- powerplant load rejection spill
- immediate replacement spill
- maintenance spill
- error in communication with Corps reservoir

It is recognized that achieving regulatory TDG levels may not be possible during spill associated with large flood (7Q10) events. However, at Rocky Reach Dam it may be possible to achieve current regulatory TDG levels during releases for fish bypass and up to the 7Q10 flows (252 kcfs) by selective operation of spillway bays.

4.1.1 Fish Spill

Spill is an ineffective method of bypassing fish away from the turbines at Rocky Reach Dam (Raemhild, et al. 1984, Steig et al. 1997) and, consequently, is not considered as the solution for the long-term fish bypass program. As an alternative to spill, Chelan PUD is focusing its efforts on increasing the fish passage efficiency and survival through the fish bypass system. Spill is utilized as a supplemental method for fish bypass for downstream migrating juvenile salmonids. Fish spill at Rocky Reach falls into two categories, Spring Spill and Summer Spill. For more information regarding spill during the spring and summer spill seasons, please refer to Section 4.1 above.

4.1.2 Flow in Excess of Hydraulic Capacity

The minimal storage and limited hydraulic capacity of the project occasionally force Chelan PUD to spill water past the project. This spill is required to maintain headwater elevations within the limits set by the project's Federal Energy Regulatory Commission license, to prevent overtopping of the project, and to maintain optimum operational conditions. With this type of release, flows up to, and in excess of the 7Q10 flood flows (252 kcfs) can be accommodated.

To reduce negative impacts of flow in excess of hydraulic capacity Chelan PUD has completed and implemented a TDG Operational Plan. Chelan PUD anticipates that this will be an operational function, which will require no structural modifications.

4.1.3 Plant Load Rejection Spill

This type of spill occurs when the plant is forced off line by an electrical fault, which trips breakers, or any activity forcing the units off line. This is an emergency situation and generally requires emergency spill. When the units cannot process flow, the flow must be passed by other means to avoid overtopping the dam.

Chelan PUD has completed and will implement a TDG Operational Plan to address this emergency situation. This will be an operational function, which will require no structural modifications.

4.1.4 Immediate Replacement Spill

Immediate replacement spill is used to manage TDG levels throughout the Columbia River basin. The Technical Management Team (including National Marine Fisheries Services (NMFS), US Army Corps of Engineers, and Bonneville Power Administration) implements and manages this spill. Immediate replacement spill occurs when TDG levels are significantly higher in one river reach than they are in another reach. To balance the TDG levels throughout the basin, spill is reduced and generation increased in the reach with high TDG levels and the energy is transferred to reaches with lower TDG levels where spill is increased. The result is higher generation in the reaches with high TDG levels, increased spill in reaches with lower TDG levels, and equal distribution of TDG levels throughout the basin.

To control TDG levels that may result from immediate replacement spill, Chelan PUD has completed and will implement the TDG Plan. We expect that this will be an operational function, which will require no structural modifications.

4.1.5 Maintenance Spill

Maintenance spill is utilized for any maintenance activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include forebay debris flushing, checking gate operation, gate maintenance, and all other maintenance that would require spill. The Federal Energy Regulatory Commission requires that all spillway gates be operated once per year. This operation requires a minimal amount of spill for a short duration annually and is generally accomplished in conjunction with fish passage spill operations.

To control TDG levels that may result from immediate replacement spill, Chelan PUD has completed and will implement the TDG Operation Plan. We expect that this will be an operational function, which will require no structural modifications.

4.1.6 Error in Communication Spill

Error in communication with the U.S. Army Corps Reservoir Control Center, including computer malfunctions or human error in transmitting proper data, can contribute to spill. Hourly coordination between hydroelectric projects on the river minimizes this type of spill, but it does occur occasionally.

To control TDG levels that may result from immediate replacement spill, Chelan PUD has completed and will implement the TDG Operation Plan. We expect that this will be an operational function, which will require no structural modifications.

4.2 Compliance Activities in 2004-2008

4.2.1 TMDL Activities

The Summary Implementation Strategy (SIS) for the Mid-Columbia TDG TMDL outlined short-term implementation actions that each project had previously initiated, or was to initiate by 2006. As per the SIS, Chelan PUD was to begin a TDG literature review, or rather an engineering assessment of potential gas abatement techniques, by 2006. This review was completed in 2003, and a copy of the report submitted to the Department of Ecology in 2004.

4.2.2 Literature Review

In addition to the engineering review completed in 2003, Chelan PUD, in partnership with the other Mid-C PUDs, funded a consultant to compile a document reviewing TDG literature from 1980-2007. This document has been completed and was presented to the Adaptive Management Team in 2008.

4.2.3 Spill Reductions

The permanent fish bypass system continues to serve as the primary fish survival tool at Rocky Reach Dam. The most efficient use of voluntary fish survival spill at Rocky Reach will be to supplement the effectiveness of the fish bypass system, when needed, to reach survival goals of the HCP.

Due to the success of the fish bypass system, Chelan PUD has been able to reduce spill at Rocky Reach. In the past, voluntary spill for fish passage has been as much as 24% of the current day's forecasted flow during the spring and 9% during the summer. In 2007 and 2008, Chelan PUD operated the juvenile fish bypass exclusively (no spill) for yearling Chinook and steelhead. For sockeye, Chelan PUD conducted a powerhouse operations test with no spill to evaluate differences in route-specific survival and Project survival with all available river flow passing through turbines. During the summer outmigration of subyearling Chinook, Chelan PUD spilled 9% of the day's forcasted average river flow for a duration covering 95% of their outmigration.

4.2.4 Potential Operational Changes

Potential operational changes that have been identified to date that are available at the project to meet state water quality standards and the required HCP spill to meet fish survival standards are:

1) changes to spill configurations
2) powerhouse operations
3) revise the operations protocol to be used when conditions of non-compliance may occur

5. PROPOSED OPERATIONS AND ACTIVITIES

5.1 Operational Spill Plan

Fish spill operations in 2009 at Rocky Reach will be implemented by Chelan PUD according to certain juvenile survival standards that have been achieved by Chelan PUD and some that have yet to be achieved.

During the juvenile fish migration season, Chelan PUD will prioritize the dispatch of generating units to achieve peak plant operating efficiency as follows 1,2,3,5,4,6,7,8,9,10,11.

Rocky Reach 2009 Spring Spill

In 2009, Chelan PUD will operate the juvenile fish bypass (JFB) for yearling Chinook and steelhead with no Project spill. For sockeye, Chelan PUD tentatively plans to conduct a survival study testing alternative day/night tagged fish release methods. During this study the powerhouse will operate under normal fish bypass operations, with no Project spill (this plan is awaiting final approval from the HCP Coordinating Committee). The goal of this study is to determine if there is a negative bias in survival studies by releasing fish during midday only, as has been done by Chelan PUD throughout previous years' survival studies.

Rocky Reach 2009 Summer Spill

Summer spill at Rocky Reach for subyearling Chinook will be 9% of day average river flow. Spill will likely begin in the first week of June, after completion of the juvenile sockeye no-spill study. Spill for subyearling Chinook may commence only after study requirements (test fish released, test blocks completed, and detections verified) for sockeye have been completed. Summer spill will continue through the 95 percent passage for the subyearling migrants. The guidelines for starting summer spill at Rocky Reach are as follows:

1. Summer spill will likely start in the first week of June, but only upon verification that the spring sockeye study is complete and arrival of subyearlings at Rocky Reach is verified.

2. Summer spill season will likely end no later than August 15, or when subyearling index counts are 0.3% or less of the cumulative run for three out of any five consecutive days (same protocol as used in 2006-08) and Program RealTime shows the 95% passage percentile has been reached.

Spill not provided for juvenile passage will be shaped to avoid delay of upstream migrants according to agreements made within the HCP Coordinating Committee and will be shaped to follow the diel distribution of the fish present.

5.2 TDG Monitoring Program

As required by issuance of a TDG exemption for the Rocky Reach Project, Chelan PUD will continue to implement a physical and biological monitoring program at Rocky Reach Dam during the juvenile fish migration season. Activities include fisheries management activities, participation in water quality forums, collection of TDG data during the migration season, and collection of biological monitoring data.

5.2.1 Fisheries Management Activities

Juvenile

The Juvenile Fish Bypass (RRJFB) will run continuously from April 1 to August 31. Operations outside these dates can occur if it is deemed necessary to encompass 95% of the fish run based on discussion with the HCP Coordinating Committee.

Adult

The adult fish passage facilities at Rocky Reach Dam consist of a fishway with the right (RPE) and left (LPE) powerhouse entrances, powerhouse collection and transportation channels, a spillway tunnel channel, a main spillway entrance (MSE), and a fish ladder. The LPE is located at mid-dam between the powerhouse and spillway. The RPE is located on the south end of the powerhouse. The fishway includes a counting station on the right bank. The system includes a pumped attraction water supply and a gravity auxiliary water supply.

For operation and maintenance purposes, the primary fish passage season is considered to be April through November. Adult facilities will be open from March 1st to December 31st each year.

5.2.2 Water Quality Forums

Chelan PUD regularly participates in the Regional Water Quality Team and Transboundary Gas Group.

5.2.3 Physical Monitoring

Chelan PUD will maintain two fixed monitoring stations at the dam to monitor TDG levels annually from April through August, one in the forebay and one in the tailrace at the approved monitoring sites.

TDG measurements will be recorded throughout the monitoring season at 15-minute intervals, enabling plant operators to adjust spill volumes to maintain gas levels to prevent exceedances of the TDG criteria. These 15-minute intervals will be averaged into hourly readings for use in compiling daily and 12-hour averages. All hourly data will be forwarded to Chelan PUD headquarters building and then onto the US Army Corps of Engineers Reservoir Control Center and posted at their site on the World Wide Web.

Chelan PUD will enter into a Professional Services Agreement with Columbia Basin Environmental (CBE) to perform monthly calibrations and equipment maintenance during the 2008 monitoring season. It is anticipated at this time that Chelan PUD will continue to contract with CBE into the future. QA/QC measures will be accomplished through training in instrument maintenance, operation, and factory prescribed calibration methods. A detailed log will be maintained for all work done on the monitoring equipment, including monthly maintenance, calibration, exchange of instruments, and any other pertinent information. Redundant measurements with a mobile instrument to verify the accuracy of the in-situ instruments will be conducted during the monthly calibrations.

5.2.4 Biological Monitoring

Chelan PUD no longer conducts annual biological monitoring at Rocky Reach.

5.3 Compliance Activities for 2009-2012

5.3.1 HCP Survival Study Operations

Because the project is operating under Phase I of the HCP, which requires survival studies be conducted during representative flow conditions and normal project operating conditions consistent with the approved study design, no significant changes can be made to operations until the end of Phase I. The actual year in which changes can be made is dependent upon the success of Phase I. At the completion of Phase I, if successful, Chelan PUD may know what levels of spill are necessary to ensure the survival goal is met. It is at this time Chelan PUD will be able to determine what gas abatement measures are feasible and necessary to meet water quality requirements and HCP survival standards.

5.3.2 Spring Spill No Spill Test

No spill will be provided for yearling Chinook and steelhead in 2008. In 2003, a study was conducted to determine the bypass efficiency for steelhead, Chinook yearlings, and sockeye. Based on the results from that study, and consistent with section 5.4a of the Rocky Reach HCP, spill was eliminated for Chinook yearlings and steelhead and set at 24% for sockeye for Phase I testing. While steelhead have met the HCP juvenile project survival standard of 93%, sockeye and Chinook have not, and spill may be used in the future for these species if empirical information suggests it is needed to reach the juvenile survival standards of the HCP. In 2008, Chelan PUD will not spill for the juvenile sockeye out migration because of a powerhouse study that modifies powerhouse operations to improve fish passage through the fish bypass system and increased survival through the powerhouse.

Spill programs for 2010-2012 are unknown at this time, as the programs are dependent upon the continued success of the juvenile fish bypass and fish survival.

5.4 Additional Requirements

Chelan PUD will operate the Project in accordance with the following:

1. <u>7Q10</u>. The 7Q10 for Rocky Reach is 252 kcfs. The Project will not be expected to comply with state water quality standards for TDG for incoming flows exceeding this value.

2. <u>Fish Spill</u>. For the purposes of compliance, the “fish spill” season is taken to occur from April 1 – August 31; and “non-fish spill” season occurs from September 1 to March 31, unless otherwise specified in writing by Ecology.

3. <u>Compliance During Non-Fish Spill</u>. During non-fish spill, Chelan PUD will make every effort to remain in compliance with the 110% standard.

4. <u>Compliance During Fish Spill</u>. During fish spill, Chelan PUD will make every effort not to exceed an average of 120% as measured in the tailrace of the dam. The Project also must not exceed an average of 115% as measured in the forebay of the next downstream dam. These averages are based on the twelve (12) highest consecutive hourly readings in any 24-hour period. In addition, there is a maximum one-hour average of 125%, relative to atmospheric pressure, during spillage for fish passage. Nothing in these special conditions allows an impact to existing and characteristic uses.

5. TDG Monitoring. Chelan PUD will maintain two fixed monitoring stations at the dam to monitor TDG levels annually from April through August, one in the forebay and one in the tailrace at the approved monitoring sites. This information is available on a real time basis to all interested parties at the US Army Corps of Engineers website (http://www.nwd-wc.usace.army.mil/report/tdg.htm).

6. Reporting Spill for Fish and TDG Exceedances. Chelan PUD will notify Ecology within 24 business hours of spill for fish and when TDG standards are exceeded. Reporting shall be electronically (via e-mail) to the hydropower project manager in Ecology's Central Region Office.

7. General TDG Abatement Measures. Chelan PUD will manage spill toward meeting water quality criteria for TDG during all flows below 7Q10 levels, but only to the extent consistent with meeting the passage and survival standards sets forth in the HCP and Fish Management Plans, as follows:

a. Minimize voluntary spill,

b. During fish passage, manage voluntary spill levels in real time in an effort to continue meeting TDG numeric criteria,

c. Minimize spill, to the extent possible, by scheduling maintenance based on predicted flows.

8. Annual TDG Monitoring Report. Chelan PUD shall submit an annual monitoring report. A draft monitoring report of the year's monitoring report shall be submitted to Ecology by October 31 of the monitoring year. Chelan PUD will submit the final report, incorporating Ecology's suggested corrections, by December 31 of the same year. The contents of the report shall include, at a minimum:

a. Flow and TDG levels, on a daily basis, with purpose of spill (e.g. fish spill, turbine down time),

b. Summary of exceedances and what was done to correct the exceedances,

c. Results of the fish passage efficiency (FPE) studies and survival per the HCP

9. Revised Gas Abatement Plan (GAP). Chelan PUD will revise the GAP annually, to reflect any changes, and new or improved information and technologies. Chelan PUD will submit a draft to Ecology for review and approval by February 28 of the year of implementation. The GAP shall be in the format of Chelan PUD's 2009 GAP, unless modifications are requested by Ecology.

10. Ecology Contact. Chelan PUD will direct its correspondence to:

Pat Irle, Hydropower Projects Manager
Department of Ecology, Central Region Office
Water Quality Program
15 W. Yakima Ave., Suite 200
Yakima, WA 98902-3452

6. REVISIONS TO THE TAILRACE MONITORING PLAN

Based on the recommendation of a study conducted by Waterways Experiment Station in 2002, Chelan PUD installed a probe on the outfall of the juvenile fish bypass in 2007 to determine if the site would be acceptable as a new permanent tailrace monitoring location that would better represent the impacts of spill on TDG levels than the Odabashin Bridge location. Because there was some concern that the fish bypass outfall location may experience eddies and other water conditions that may result in poor representation of the impacts of spill on TDG, Chelan PUD maintained the Odabashin Bridge site and collected data for nearly two seasons at the outfall location to ensure the data would be representative before permanently relocating the site.

Data collected from the site was compared to predicted levels computed using an equation developed by Michael L. Schneider and Steven C. Wilhelms of the U.S. Army Engineer Research and Development Center in a 2005 report on Operational and Structural Total Dissolved Gas Management at Rocky Reach. Development of the model included actual data from numerous locations in the forebay and tailrace (including near the fish bypass outfall) of Rocky Reach collected during a field study conducted in 2002. The model uses TDG data from the existing tailrace monitoring location and spill volume to predict TDG levels at the fish bypass outfall location. Details of this prediction tool and how it was developed are included in the Schneider and Wilhelms report. The data comparison supported the theory that the fish bypass outfall location would provide a representative sample of spill impacts on TDG. Therefore, late in the 2008 monitoring season Chelan PUD permanently relocated Rocky Reach tailrace monitoring site to the juvenile fish bypass outfall.

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