Columbia River Regional Forum
2009 TDG Monitoring End of Year Review
November 17, 2009

1. Meeting Purpose and General Overview

Today's meeting participants presented an overview of the Fixed Monitoring Stations monitoring results of total dissolved gas and water temperature for 2009 throughout the Columbia River basin. Laura Hamilton (COE) served as chair and facilitator of the meeting.

In the past, the COE has required redundant monitoring, but that requirement has been suspended if completeness of data sets is 95% or greater, Hamilton said. Today's presentations covered TDG and temperature monitoring results which are summarized in the district reports that are included as appendices in the annual TDG and Temperature report the COE Division office sends to Washington and Oregon to fulfill TDG waiver requirements. These TDG and temperature reports are the COE's annual quality assurance and quality control report.

2. COE Portland District TDG and Temperature Monitoring Review

Dwight Tanner (USGS) gave a presentation on monitoring results for the TDG sites on the lower Columbia managed by the USGS Portland office – The Dalles forebay and tailrace; John Day tailrace; The Dalles forebay and tailrace; Bonneville forebay and tailrace; and the Cascade Island, Warrandale, and Camas-Washougal gages below Bonneville Dam.

Several times this year, forebay sites showed TDG readings above 115% saturation. All tailwater sites had readings above 120% TDG at some point except The Dalles tailwater. Field checks showed readings within 1% TDG with two exceptions. There have been equipment problems this year.

Field checks for barometric pressure were within 2 millimeters of mercury. Water temperatures were within 0.2 degrees C.

Regarding data completeness, 99.4% of data taken in real time were found to be valid. Tanner showed the group a box plot of TDG readings at the USGS sites taken every hour during spill season. Almost all of the sites had readings above the variance at some hour; USGS will look more closely at some sites. For example, at John Day tailrace there were two response curves for a given spill level of 60-80 kcfs. With moderate spill of 80-100 kcfs, TDG values rose above 115% and sometimes even above 120% at this site. There were 3 problems at John Day tailrace and 2 cases of leaking membranes. At Bonneville forebay, there were 2 cases of broken membranes.

USGS has been looking at how the COE deals with variances as a high 12-hour average. Cascade Island gage, immediately below Bonneville Dam, had a number of exceedances of 120% TDG, related to high spill levels. Camas-Washougal gage, 25 miles downstream of Bonneville, is treated as a forebay site. It had several exceedances in 2009.

Temperature checks were within a tenth of a degree C. Equipment is calibrated in the USGS lab under very tight pressure, so any problems are generally not with the sensor.

There have been problems at Camas-Washougal gage of critters (amphipos) attaching to the probes, which causes the membrane to fail. USGS is monitoring that situation closely. Currently USGS has 3 winter sites running below each dam.

There were a number of questions and answers on the use of Camas-Washougal gage. This year, the COE is court-ordered to continue using the fixed monitoring system as it was in 2007 and rolled over in 2008, Hamilton explained. BiOp litigation has prevented the COE from implementing changes in state water quality standards. Susan Braley (WDOE) suggested not calling the Camas-Washougal TDG readings exceedances when they go over 115% because the word indicates a violation of standards, and that wasn't the case. The COE has done an accounting of the new Washington method of defining exceedances, but is still mandated to manage spill to the 2007 standards, Hamilton said. Hopefully the litigation will be resolved soon so the new standards can be implemented.

There was also discussion of membrane failures that were caused by an accumulation of critters. The MS-5 sensors are hard to use because at times they don't track quickly, and if measurements are taken only once an hour, it's a problem, Tanner said.

3. COE Seattle District TDG and Temperature Monitoring Review

Kent Easthouse (COE) gave a brief overview of monitoring sites at Chief Joseph, Albeni Falls and Libby dams. The Seattle COE district manages 5 monitoring sites – Libby tailwater; Chief Joseph forebay and tailwater; and Albeni Falls forebay and tailwater. Calibrations are reviewed every 2 weeks. Albeni Falls and Libby are transmission stations with solar power, and there's a problem at Albeni falls with the battery to the solar panels losing its charge.

Data completeness was greater than 90% at Chief Joseph and Albeni Falls forebays. Results for Libby forebay were also good. The only gaps were at Albeni Falls tailwater, caused by problems with the solar-powered battery and a probe being out of the water when flows dropped. The problem with the probe was solved by repairing the pipe at Albeni Falls tailwater station. With no spill at Albeni Falls, that probe is less representative of river conditions than others, especially in later summer, John Lemons (Columbia Basin Environmental) said.

Data completeness in 2009 was better than last year's 80%; the improvement was attributed to fewer lightning strikes and more moderate flows.

A spill test at Chief Joseph Dam found the new deflectors work well, and TDG levels stayed below 120% even with spill of up to 140 kcfs. Chief Joseph forebay TDG levels basically reflect what's coming down the river from Grand Coulee. Though temperatures at Chief Joseph were above 16 degrees C from mid-July through September 30, and they were18 degrees from mid-August through September 30, TDG readings at Chief Joseph forebay and tailwater were nearly identical. There was no spill at Libby Dam in 2009, meaning gas levels there stayed low. Temperatures at Libby stayed quite cool. Libby's selective withdrawal system is used to keep water temperatures within Montana's standards.

4. COE Walla Walla District TDG and Temperature Monitoring Review

Dwight Tanner (USGS) and Dewey Copeland (USGS) presented ***TDG and Temperature*** monitoring results for 15 stations, 9 of which are seasonal and 6 full-time. This year's USGS data report will include results for only the 9 seasonal sites; the 2010 report will cover all 15 sites. They include McNary forebay, the four Snake River dams up to Dworshak, and four riverine sites including the Anatone gage on the Snake River.

USGS field equipment includes 34 sondes and 14 digital barometers, most of which are powered by solar batteries. Two hand-held barometers to calibrate site barometers are also solar-powered. USGS purchased 3 MS-5A sondes and the COE purchased 6 this year for the monitoring program. The MS-5 sondes respond more slowly to conditions than the 4A sondes, taking more than an hour compared to 20-30 minutes, Copeland said. The manufacturer is making it a top priority to resolve this problem.

Data completeness during the 2009 spill season was 99.8% for barometric pressure, 99.5% for TDG, and 99.9% for water temperature. For the entire reporting period, data completeness was 99.8% for barometric pressure, 99% for TDG, and 99.8% for water temperature, despite 8 days of no data at Lower Granite. Most data gaps were due to bad membranes or other equipment failure. Data completeness was 100% for McNary forebay; Ice Harbor forebay and tailwater; Lower Monumental forebay; Lower Granite forebay; and Lewiston, Idaho. Three sites – Ice Harbor tailwater, Lower Granite forebay, and Dworshak forebay and tailwater – account for most of the missing data.

Kent Easthouse (COE) presented a graph summarizing 184 data checks the COE did of the USGS stations throughout the year. Barometric pressure readings both pre- and post-deployment were within plus or minus 0.6 mm mercury for 80% of data. Water temperature readings, double-checked in the lab,

were within 0.2 mm mercury, and at least 80% of data were within plus or minus 0.1 degree C. TDG readings were all within plus or minus 0.2% saturation at all sites. These findings are consistent with USGS data for the lower river.

For the 15 sites USGS operates for the Walla Walla COE district:

- 1.4% of all water temperature, barometric pressure and TDG data were either missing or anomalous.
- Barometric pressure median values pre- and post-deployment were minus 0.2 and minus 0.1 mm respectively.
- Water temperature median values pre- and post-deployment were 0 degrees C and minus .02 degrees C respectively.
- Comparison of readings from two sondes showed a median difference of 1.3% in TDG readings.

5. Bureau of Reclamation TDG and Temperature Monitoring Review

Norbert Cannon (BOR) and John Lemons (Columbia Basin Environmental) discussed the BOR's water quality monitoring program at 3 year-round sites on the Columbia – the international boundary site, Grand Coulee forebay and tailwater, and a site on the south fork of the Flathead River below Hungry Horse Dam.

The Hungry Horse site runs from March through September, Lemons said. Selective withdrawal there helps to control water temperatures, resulting in spikes in the Hungry Horse data whenever the operation changes. Barometric pressure, TDG and temperature data all reflect the period of selective withdrawal.

Some barometric pressure data at Grand Coulee were lost because vibration damaged a sensor. Readings at the international site were within 0.5 millimeter for TDG levels and 0.5 degree C for temperature. A loss of 275 hours of data at the year-round Grand Coulee tailwater site was caused by a power outage. At the boundary site, a torn TDG membrane accounted for a day's worth of lost data, and lightning damage to a probe accounted for 2 days of lost data. All other BOR monitoring sites had 100% data completeness.

6. Chelan County PUD TDG and Temperature Monitoring Review

This year, the only change to Chelan PUD's water-quality monitoring system at Rocky Reach and Rock Island dams was a communication upgrade, Waikele Hampton (Chelan PUD) reported. The upgrade helped with data retrieval at the Rock Island tailrace site. She presented a graph of TDG readings in the forebay and tailwater of both dams. Of all spill from April 1 to August 31, 96.09% at Rocky Reach and 99.71% at Rock Island dams were to augment fish passage. The rest was involuntary spill.

Data completeness for the Rocky Reach forebay and tailrace and the Rock Island forebay was 100%. For the Rock Island tailrace, the site of the communication upgrade it was 97.4%. This year has been the best Chelan PUD has had in terms of data completeness thanks to the upgrade.

In 2009 there were 5 exceedances in the Rocky Reach forebay. There were none in the Rocky Reach tailrace or the Rock Island forebay and tailrace. There were either 16 or 14 exceedances in the Wanapum Dam forebay, depending on how double-counting under the new Washington system of reporting is handled.

Lemons presented monitoring results for 4 sites that Columbia Basin Environmental manages for Chelan PUD – the Rocky Reach forebay and tailwater, and Rock Island forebay and tailwater. Several days' worth of data were lost at Rock Island tailwater this year when the probe was out of the water for several days, probably caused by vandalism.

7. Grant County PUD TDG and Temperature Monitoring Review

Ross Hendricks (Grant PUD) described how the PUD calculates compliance values and monitoring results. Grant PUD monitors TDG levels based on several requirements listed in the newly issued FERC license for Priest Rapids and Wanapum dams.

At Priest Rapids, temperatures and TDG levels are tested year-round on an hourly basis in both the forebay and a tailwater site 3 miles downstream. In addition, they do grab sampling and turbidity analysis every 2-3 weeks. A new spill design is now being tested at Priest Rapids. Data from TDG and temperature readings are posted to the Grand PUD website with a 2-hour time lag. At Wanapum Dam, most of the spill for fish goes through the new fish bypass (see agenda item #9 below).

Equipment at monitoring sites is calibrated every 2 weeks during fish spill season and every 3 weeks during non-spill season. Grand PUD's system highlights any values that might be erroneous. The goal for 2009 was to have less than 5% data loss, a goal that was met. Of nearly 1,500 hours of data for all 4 sites in 2009, there were only 271 data points missing, or 1.8% of data lost (compared to 1.5% of data lost last year).

Hendricks gave an example of how Grant PUD has been handling the new WDOE method of calculating TDG exceedances. Because most spill occurs at night when power demands are low, higher TDG levels tend to occur toward the end of the day. This can easily continue into the early hours of the next day, resulting in two exceedances for the same spill event. In the example Hendricks gave, dropping the 2 highest hourly values from calculation of an average TDG

value for the second day caused the average of the 12 highest consecutive readings for that day to drop from over 120% to 116% saturation.

Grant PUD reviews its TDG calculations daily, removing these discrepancies from the tally of exceedances and reporting them to WDOE, which has supported this approach. In light of that acceptance, Grant PUD favors the new method from a biology and accounting standpoint.

At a meeting of the mid-Columbia PUDs last June, participants agreed that calculation of TDG readings at consecutive hours makes sense biologically because the duration of exposure is critical in terms of effects on fish and other aquatic species, Braley said. PUD representatives therefore decided not to drop the word “consecutive” from the definition of an exceedance but to work through the accounting implications. As a result of that meeting, WDOE and the mid-Columbia PUDs have been working on a draft narrative of how to handle TDG accounting so that facilities aren’t doubly charged with exceedances.

Discussion turned to differences in the Washington and Oregon methods of calculating an exceedance. For the past 2 years, the COE has been tracking the number of exceedances using both methods, and the new Washington method definitely results in more exceedances, Hamilton said. However, there are times when the Oregon method results in an exceedance and the Washington method doesn’t. The COE manages spill to the most restrictive criteria.

Washington intends to provide more guidance on how to interpret the new standard, Chad Brown (WDOE) said. The definition of a day could turn out to be different for each operation. WDOE’s goal this winter is to put this in writing so the mid-Columbia PUDs can apply the new method consistently.

The Grant PUD fish spill program calls for 20 kcfs of spill through the Wanapum fish bypass and 20-24 kcfs through Priest Rapids, Hendricks said. A major finding this year was that the use of pre-emptive spill a few hours before an expected high flow event will help reduce or eliminate sudden TDG spikes.

This year there were 14 (not 16) exceedances at Wanapum forebay (the other 2 were double-countings), with only 1 exceedance at Priest Rapids forebay. The discrepancy is because there was not much degassing between dams. The Wanapum fish bypass passes more fish and manages TDG by using a skimming flow that produces less gas. Grant PUD is upgrading all the turbines at Wanapum and in 2012 will increase powerhouse capacity, which will reduce involuntary spill. An ongoing study of spill alternatives at Priest Rapids is expected to help keep TDG levels low there.

8. Douglas County PUD TDG and Temperature Monitoring Review

Josh Murauskas (Douglas PUD) described Douglas County's TDG management efforts at Wells Dam, which is unique because the powerhouse, spillway and fishways are all combined in one unit. Modeling efforts at Wells found that the prevailing wisdom of spreading flows out actually resulted in increased TDG levels because water would plunge to depth and entrain the gas. Instead, bulk spill in one of the center spill bays (there are 10 bays total) has been found to degass the water so effectively that TDG levels are 5% lower with bulk flows than with spread flows. This new information will help Douglas PUD maximize TDG compliance at Wells Dam during 7Q10 flow events.

Margaret Filardo (FPC) asked whether Douglas PUD has analyzed fish passage with the bulk and flat spill patterns. Wells Dam has the highest fish survival rates in the basin, perhaps because the turbine intakes are so deep that fish can't find them, Murauskas replied. Instead, fish are sucked through the upper 20 feet of the water column, which has no effect on survival rates.

John Lemons then presented TDG monitoring results that Columbia Basin Environmental has been providing for Douglas PUD. There are 2 probes in the Wells forebay and another probe 3 miles downstream of the dam. These are calibrated once a month during passage season (as Chelan PUD's are). All TDG readings at Wells Dam this season were accurate within plus or minus 1 mm, and temperature readings were accurate within 0.10 of a degree C.

9. Wanapum Fish Bypass Research

Hendricks gave a presentation on the Wanapum fish bypass, which he also presented at the Transboundary Gas Group meeting last month. The new bypass began operating in 2008, but passage rates through the spillway were falling below the BiOp survival standard of 95% juvenile salmon survival, and gas levels were high. Survival rates through the powerhouse, however, were good.

After studying the situation, Grant PUD cut a hole in the concrete and built a fish bypass that can handle up to 20 kcfs spill. Its vertically inclined gates can pass varying rates of flow. The bypass was designed with good attraction flows that are surface-oriented at the exit to help minimize TDG levels, reduce tailrace scour and help pass fish safely.

An objective of the TDG study was to quantify levels associated with operation of the bypass under different flow conditions. The main goal was to determine whether the bypass could be operated in accordance with state water quality standards as well as BiOp survival standards. A secondary objective was to compare the gas pressures at the current monitoring site 2,000 feet downstream of the dam with those at a new site 3 miles downstream.

During the 30-day study from July 26 to August 24, 2008, inflows at Wanapum were 19-20 kcfs and powerhouse flows varied from zero to a near-

maximum capacity of about 140 kcfs. There were 44 instances when conditions were held steady for 3 hours so that powerhouse flows could be directly correlated with gas production. By studying the varying tailwater elevations that resulted, researchers found that lower tailwater elevations buffered the effect of surface flow on TDG levels.

Both objectives of the study were successfully met. For all tests run, including those of worst-case conditions, the highest gas level produced was 116%, significantly less than the 120% state standard. Flows of 18-20 kcfs through the bypass produced gas levels of 111-116%. Higher powerhouse flows tended to produce lower TDG values. Throughout the range of powerhouse operations, gas levels stayed below the peak of 118%. It appears that operation of the bypass involves no compliance issues, even when water coming into the dam has high gas levels. The monitoring site 3 miles downstream was validated as a surrogate for the present gage 2,000 feet downstream; readings at both of the sites correlated closely. These notes prepared by technical writer Pat Vivian.

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