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Columbia Generating Station NPDES Groundwater Study Review

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Columbia Generating Station NPDES Groundwater Study Review

by
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This report was prepared by a licensed hydrogeologist.
A signed and stamped copy of the report is available upon request.

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Introduction

The Washington State Energy Facility Site Evaluation Council (EFSEC) contracted with the Department of Ecology to review two documents relevant to the National Pollutant Discharge Elimination System (NPDES) permit as it relates to ground water. This report consists of the requirements for this review and related comments and recommendations, as well as a report on previous studies and previous reviews as it relates to the scope of this project. The two documents for review are:

1. **Scope of Work**

   The Scope of Work is required by Permit Condition S11.B.1. *The Columbia Generating Station NPDES Ground Water Study Scope of Work* is dated June 28, 2007.

   According to the Scope of Work document, the following questions will be addressed by the ground water monitoring study:

   - Have changes to ground water quality occurred due to discharges at the two outfalls?
   - Are the discharges in compliance with the ground water quality standards?
   - Are effluent limits or ground water quality limits needed for the permit?
   - Does the existing monitoring program need any revision?

   The capability of the monitoring program to answer the above questions depends on whether the well locations, well construction, parameters sampled and frequency of sampling are sufficient given the discharge locations and characteristics. The Quality Assurance/Quality Control (QA/QC) also must be sufficient so that there is confidence that the monitoring results reflect the ground water quality to the extent possible.

2. **Quality Assurance Plan**

   The Quality Assurance Project Plan (QAPP) is required by Permit Condition S11.B.2. This is the basis for QA/QC for the monitoring program.

Site visit

On October 22, 2008, I visited the site to observe sampling and toured the parts of the facility relevant to this scope of work. Recommendations are included below.

Review and recommendations

On review of the above documents and background material as well as observations during the site visit, I have the following comments:

- Overall, the QAPP looks very good. The plan generally meets the requirements of the *Implementation Guidance for Ground Water Quality Standards* (Guidance).

- The hydrogeologic characterization is extremely thorough. The 2007 Battelle Report entitled *Summary of Hydrogeology and Evaluation of Existing Groundwater Monitoring Wells for outfalls 002 and 003 at the Columbia Generating Station* by P.D. Thorne provides excellent information.

- The monitoring wells are in the appropriate locations.

- The plan calls for purging three times the volume in the well. The purge technique in the Guidance calls for purging until field parameters are within five percent for each well volume purged. The field parameters should be monitored using a flow-through cell and should include electrical conductivity, temperature, pH, and dissolved oxygen. The Guidance states that dissolved oxygen is an important field parameter for determining when enough purging has occurred so that the sample is representative of ground water in the aquifer. Dissolved oxygen is a useful parameter for evaluating the geochemical conditions of ground water. See Section 5.2.6 of the Guidance for more information.

- Metals are being sampled as Total Recoverable and are unfiltered. The Guidance states that a low flow purge and sampling technique should be used to capture both the total and dissolved fraction of metals. The Guidance recommends a low flow rate of 0.2 to 0.3 liters/minute for metals analysis with no filtration. Although not specifically mentioned in the QAPP, the sampling is being done using a low flow rate. It would be useful to report the actual rate of flow.

- The cations and anions listed in the Guidance in section 5.2.3 are in the sampling plan except for potassium, bicarbonate and carbonate. Cations and anions may be used to evaluate the type of water quality geochemistry and the changes in water quality that may be occurring due to the discharge. Analysis of cations and anions also is useful as a QA/QC check on analyses. For a complete discussion of the usefulness of cations and anions, see section 5.2.3 of the Guidance. It is recommended that this analysis be done at least once a year at the same time of year.

- The sampling plan should list the individual Volatile Organic Compounds (VOCs) that are being tested for explicitly. This list should include the trihalomethanes.

- It isn't clear to me what the source of the elevated fluoride is.

  Previous reviewers (Cook, 1999; Stormon, 2005) indicated that although chloroform and fluoride levels were below the ground water standards, they were higher in samples from downgradient wells than in samples from upgradient wells. Cook suggested that enforcement limits may be called for, in view of the antidegradation provisions of the ground water quality standards. Stormon suggested that there was some question as to whether the ponds were degrading water quality, but suggested continued monitoring of the discharge was adequate, since the levels of chloroform and fluoride were low. The ground water

criterion for fluoride is 4 mg/L, and the ground water criterion for chloroform is 7 ug/L (Chapter 173-200-040 WAC).

The question I had was related to the source of the chloroform and fluoride. Chloroform is a typical disinfection by-product of chlorination of drinking water. Fluoride can be added to drinking water (mostly in city systems), used as an additive, or it could be naturally occurring. I do not know whether there is fluoride in the discharge.

The decisions about enforcement limits in the next permit cycle for these two constituents and all the other parameters would be made after the monitoring results for the two years (eight quarters) are available. These results would be analyzed to determine impacts to ground water from facility discharges and what enforcement limits should be applied for all the constituents, including chloroform and fluoride, as applicable.

- The QAPP states that it is useful to continue to monitor MW-3 to differentiate potential impacts related to cooling tower operations and spray pond filter backwash discharges. MW-3 should be sampled for parameters that are in the discharge related to cooling tower operations (overspray and overflow). These should include bromide or total bromine, total phosphorus and azoles.

- We did not enter the diesel building or the turbine generator building. We discussed management of potentially polluting substances and the issue of floor drains. The facility should follow practices that do not allow fuels or any potential VOC's or petroleum products to enter floor drains to prevent discharge to Outfall 002. There isn't any sampling provision for Polycyclic Aromatic Hydrocarbons (PAHs) or Total Petroleum Hydrocarbons (TPH). VOC's should explicitly include PAH, TPH, BTEX (benzene, toluene, ethylbenzene, xylene) and any other constituent that is likely in the discharge for monitoring wells downgradient of Outfall 002.

- There have been no discharges to Outfall 003 since the treatment system was adjusted so that the filters do not need to be backwashed. The source of the lead above ground water quality standards detected at the downgradient monitoring well was found to be lead-based paint from the spray ponds.

- The spray ponds are concrete lined. The sanitary waste lagoons are HDPE lined. The percolation beds are the discharge point for the sanitary waste effluent. The sanitary waste lagoons are regulated under an EFSEC resolution and are not within this scope of review.

- Radiological discharges are not in the scope of the NPDES permit and are regulated by EFSEC under the Nuclear Regulatory Commission (NRC).

Background report

The following is information and findings from review of background information.

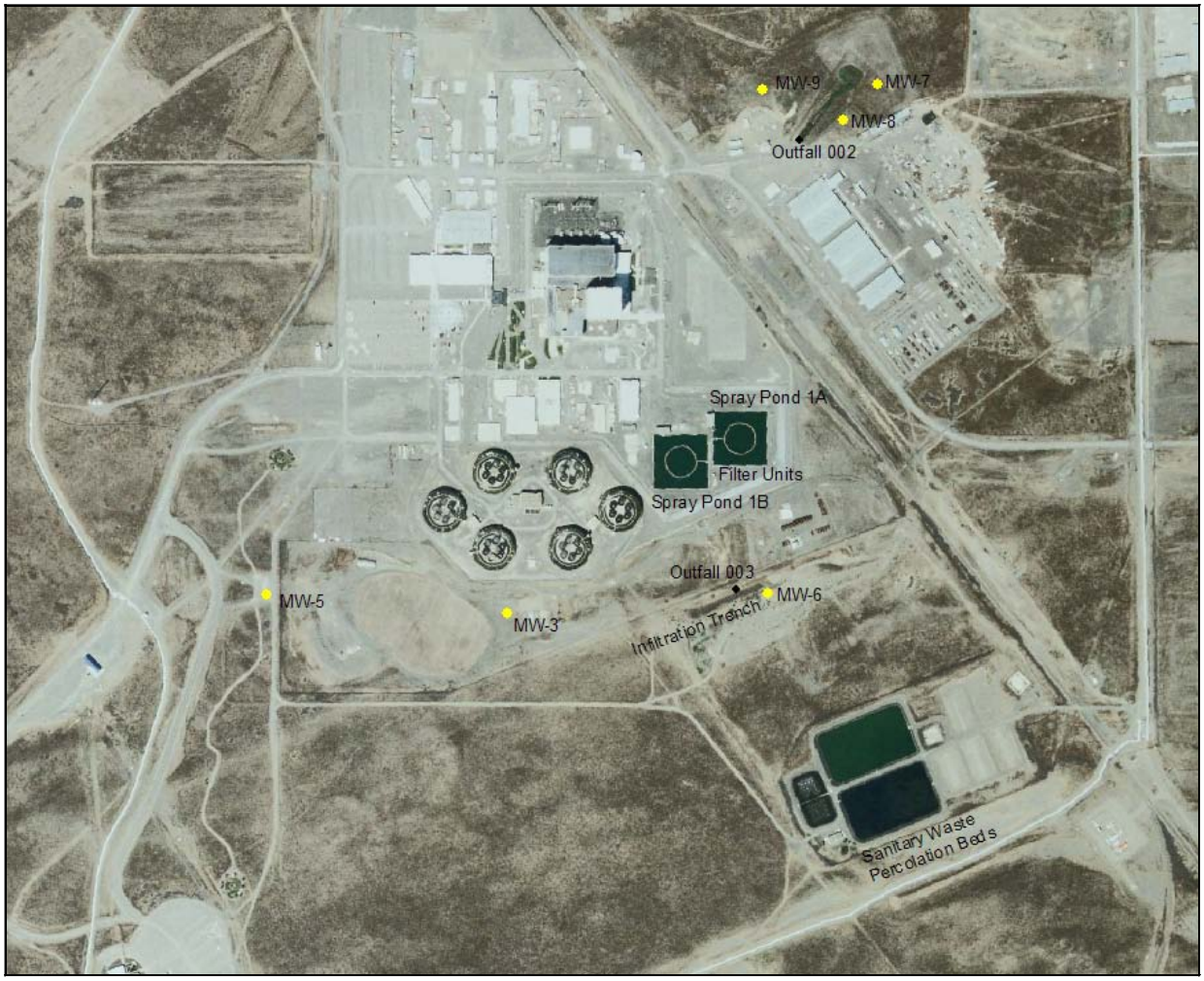

Figure 1: Approximate monitoring well locations and discharge sites outfall 002 and outfall 003.

The Battelle report thoroughly discusses the hydrogeology of the site and the surrounding area, including stratigraphy, aquifers, water table depth, ground water flow gradient, rate and direction. The general ground water flow direction is from west to east. The report discusses upgradient sources of ground water contamination from the Hanford site, discusses the ground water quality upgradient and downgradient of the Columbia Generating Station from previous monitoring, and interprets possible causes of ground water quality changes across the site.

The well locations were evaluated using a method called Monitoring Efficiency Model by Golder in 1996, and the Battelle author re-evaluated the results using current information.

Outfall 002 upgradient well

MW-9 is proposed as the upgradient well. MW-9 has been potentially influenced by discharge of water from testing the fire-protection pumps. According to the Battelle report, elevated concentrations of calcium, chloride, magnesium, sodium, sulfate, and specific conductance could possibly be from flushing of the salts from the desert soils. The Battelle report recommends continuing to use MW-9 as the upgradient well and continue to monitor since the levels for the above parameters are below regulatory levels.

Based on information provided in the Battelle report, it appears very reasonable to use MW-9 as the upgradient well with continued monitoring.

Outfall 002 downgradient wells

The Battelle evaluation concludes that MW-7 and MW-8 remain valid well locations for monitoring discharges from Outfall 002. The MEMO model requires site specific input, parameter estimates and interpretation. Since these elements were not provided as part of the submittal, I am unable to comment on the use of the model. Based on review of the hydrogeologic characterization, the conclusion that MW-7 and MW-8 are valid well locations appears to be reasonable.

Outfall 003 upgradient wells

Monitoring Well MW-3 is upgradient of Outfall 003 but downgradient of the closed RCRA landfill. Monitoring Well MW-5 is a better choice for the upgradient well since establishment of background ground water quality must be uninfluenced by site activities according to the Guidance. I agree with the QAPP that MW-3 is useful to monitor, both because it is downgradient of the landfill and upgradient of Outfall 003, and as noted in the QAPP, may help differentiate potential impacts from the cooling tower operations and discharges to Outfall 003.

Well construction

Well construction is in conformity with the Guidance. The well logs for the monitoring wells are attached. The monitoring wells are constructed of two-inch PVC pipe within a six or eight-inch borehole. The wells are completed with a two-inch diameter PVC screen with 0.013 slots. The filter pack is 10/20 silica sand that extends three feet above the screen.

Table 1: Monitoring Well Construction Summary

Well ID	Drilling Method	Total Depth (feet below ground surface)	Lithology at the Screened Interval	Ground Surface Elevation	Depth to Water (feet below ground surface)	Screen Interval (feet below ground surface)
MW-3	Tubex XL Air Rotary	62	Very dense dark yellowish brown fine to coarse gravel, little fine to coarse sand, trace silt.	439.94	51.46	49 to 59
MW-5	Tubex XL Air Rotary	78	Very dense dark yellowish brown fine to coarse gravel, little fine to medium sand, trace silt.	453.16	63.98	60 to 75
MW-6	Hollow Stem Auger	46	Gravel with cobbles and sand.	423.50	37.5	36 to 46
MW-7	Hollow Stem Auger	27.5	Gravel and cobbles.	403.80	21.0	17.5 to 27.5
MW-8	Hollow Stem Auger	35.0	Gravel and cobbles with sand.	410.90	28.0	25 to 35
MW-9	Hollow Stem Auger	37	Gravel and cobbles.	410.10	30	27 to 37

Summary of Discharges

Outfall 002

Wastewater Discharge	Content	Volume, gallons	Frequency	[1]Estimated Yearly Volume, gallons	[1]Percent of Total Yearly Discharge
Filter backwash from potable water treatment system.	Flocculent; removed natural impurities.	15,000 to 25,000	2 to 3 times per week	1,560,000 to 3,900,000 (average = 2,730,000)	28.48 %
Wastewater from the demineralized water treatment system.	Instrument flush water; reverse osmosis reject water, removed natural impurities; chlorine? THM's?	17,000	Estimated average daily	6,188,000	64.56 %
Storm water runoff from plant building roof drains.	Roof material? Vents?	1800	Estimated annual average per day	655,200	6.84 %
Wastewater from the General Service Building sump and floor drains in the Diesel-Generator Building.	Water from HVAC units; intake air washers; pump and valve leakage; demineralized water storage tank overflows; floor washings.	3,000	2 to 3 times per year	6,000 to 9,000 (average = 7,500)	0.08 %
Diesel-Generator Building, continued.	Annually drained water from the diesel engine cooling jackets, with a nitrite corrosion inhibitor.	3800	About once per year	3,800	0.04 %
[2]Wastewater from sumps located in the Turbine Generator Building.	Water from equipment leakage, washing, maintenance activities (e.g. condenser drainage).	See Note 2	See Note 2	See Note 2	See Note 2
[3]Periodic testing and flushing of the fire protection system, occurs in the area around MW-9.			Infrequent		

[1]Estimated from reported volume and frequency of discharges.
[2]This is an Optional discharge to Outfall 002 if tested and found non-radioactive; Otherwise this discharges to Outfall 001 via the radioactive wastewater treatment system.
[3]This discharge may be routed to Outfall 002, the ground or to the sanitary sewer. Golder, 1996, states that this infrequent discharge is to WNP-2 dry wells (page 12 section 4.1).

[3, continued] Columbia Generating Station Wastewater Source Descriptions, page 3: Operation and testing of the fire protection system is another source of water discharges to the pond. Periodically portions of the system are removed from service for flushing and flow-rate tests. These batches of several thousand gallons may also be routed to the sanitary waste system or directly to the ground depending on the location and system configuration.

Outfall 003

Wastewater Discharge	Content	Volume, gallons	Frequency	[1]Estimated Yearly Volume, gallons	[1]Percent of Total Yearly Discharge
[2]Filter backwash water	Filters algae and suspended material in the service water system; Periodic additions of hydrogen peroxide (50%) and sodium silicate are used for bio-fouling control and corrosion inhibition in the ponds, respectively.	10,000 to 15,000	May through October, every 3 days to three weeks	86667 to 910000 Average = 498,333	100

[1]Estimated from reported volume and frequency of discharges.

[2]The filter backwash water was from the sand/gravel "side-stream" filtration system. This system is next to the spray ponds. It was used to filter algae and suspended material in the service water system. Periodic additions of hydrogen peroxide (50%) and sodium silicate were used for bio-fouling control and corrosion inhibition in the ponds, respectively. This filtration system is not in use anymore and there has not been a discharge to Outfall 003 for more than five years.

Previous Reviews

1997: Zelma Jackson, Dept. of Ecology Nuclear Waste Program, did a comprehensive review of the Hydrogeologic Study Plan for WNP-2 effluent discharges. She found that the plan satisfied the requirements of the Site Certification Agreements, the National Pollution Discharge Elimination System permit, specific resolutions, and various state regulations.

1999: Kirk Cook, Dept. of Ecology Water Quality Program, reviewed the ground water monitoring program for WNP-2 effluent discharges. His comments are summarized as follows:

- Collect at least eight samples collected over a period of at least a year to characterize background water quality and to account for natural variability. This corresponds to statements in the Guidance (pg. 24).
- Time the sampling of downgradient monitoring wells in relation to when effluent is discharged and sampled.
- Consider moving the upgradient wells closer to the discharge sites.
- Chloroform and fluoride levels appear to be increasing downgradient of the discharge. These results are below the ground water quality standards. However, the standards call for enforcement limits below the standard (depending on background water quality) to provide for antidegradation of ground water quality.
- Quarterly monitoring should continue and interim limits should be set based on the data collected to that point. Final limits should be set after the next year's quarterly sampling is completed.

2005: John Stormon, Dept. of Ecology Water Quality Program, reviewed the WNP-2 Ground Water Monitoring Program. This review included the final report on ground water monitoring program, April 1999 and the discharge summary tables for 2002-2005. His comments are summarized as follows:

- The limited ground water monitoring data provided in the 1999 report shows a reduction in levels from upgradient to downgradient sample results for most reported constituents.
- Reported levels for chloroform and fluoride in ground water appear to be higher in the downgradient wells than in the upgradient wells, leading to some question of whether the ponds are degrading the ground water quality.
- The discharge summary tables for 2002-2005 indicate that both fluoride and chloroform levels in the discharge are low.
- The data does not indicate that this facility is degrading ground water quality with their discharges to ground.

- Sampling and analysis of discharge water should continue.
- As long as the analytical results continue to show low levels in the discharge, additional ground water monitoring is unnecessary.

Conclusion

The Columbia Generating Station staff members are doing an excellent job with their requirements. The next steps will involve evaluating the sampling results statistically following the Guidance. This will set the stage for determining enforcement limits. The Guidance has a thorough explanation of this procedure.

References

Columbia Generating Station NPDES Groundwater Study Scope of Work, dated June 28, 2007. This is the document related to requirement S11.B.1 of the NPDES permit.

Columbia Generating Station Groundwater Quality Study – Quality Assurance Project Plan, dated September 28, 2007. This is the document related to requirement S11.B.2 of the NPDES permit. The Quality Assurance Plan is the basis for QA/QC for the monitoring program.

Hydrogeologic Study Plan for WNP-2 Effluent Discharge, dated May 12, 1997.

Supply System Nuclear Plant No. 2 Final Report on Groundwater Monitoring Program, April 12, 1999.

Thorne, P.D., 2007 Battelle Report entitled *Summary of Hydrogeology and Evaluation of Existing Groundwater Monitoring Wells for outfalls 002 and 003 at the Columbia Generating Station*.