UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232

December 12, 2013

Shannon Khounnala
Energy Northwest
Mail Drop PE20
PO Box 968
Richland, WA 00352-0968

Re: Columbia Generating Station Cooling Water Intake Screen
NMFS Consultation No. (I/NWR/2011/05286)

Dear Ms Khounnala:

This letter responds to information you, other Energy Northwest (ENW) staff, and Dr. Chuck Coutant provided to us during our meeting on November 13, 2013. We appreciate the time and effort ENW expended to better inform us as to the risks of fish impingement and entrainment (I&E) posed by the project's cooling water intakes. We have reviewed the materials provided during that meeting to determine whether they sufficiently address the issues that have caused us to object to the National Pollutant Discharge Elimination System (NPDES) permit Washington's Energy Facility Site Evaluation Council (EFSEC) is currently proposing to issue. Our review is attached. We remain concerned that the existing Columbia Generating Station Cooling Water Intake Screen (CWIS) poses a risk of injury or mortality to fry and juvenile salmon and steelhead that rear near or migrate past the facility, including fish protected by the Federal Endangered Species Act (ESA).

We continue to recommend that the CWIS be modified to minimize the potential for I&E. We further recommend that monitoring actions that require electrofishing in the Columbia River for purposes of the NPDES permit be covered by an ESA 'take' authorization. The state's NPDES permit is essential for successfully completing an ESA Section 7(a)(2) consultation, biological opinion and incidental take statement, for the Columbia Generating Station's operation and maintenance under its Nuclear Regulatory Commission license. A NPDES permit that is sufficiently protective of ESA listed salmon and steelhead will allow for an operation of the Station that can comply with ESA standards.

Please do not hesitate to call us if you have any questions. Rich Domingue (503-231-6858) can provide information on formal consultations, and Bryan Nordlund, P.E. can answer questions regarding screen design and operation.

Sincerely,

Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Area Office
NOAA Fisheries, West Coast Region

cc: Jim LaSpina
Energy Facility Siting Specialist
Ecology/Energy Facility Site Evaluation Council
P.O. Box 43172
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Enclosure: Memorandum from Bryan Nordlund:
Review of recent info regarding Columbia Generating Station

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MEMORANDUM FOR: Ritchie Graves

CC: Rich Domingue

FROM: Bryan Nordlund

SUBJECT: Review of recent info regarding Columbia Generating Station

1985 Entrainment Report[1]

I reviewed the material provided by Energy Northwest (ENW) staff at the November 13, 2013 meeting held in our Portland office. Specifically, I reviewed Section 12.0 from "Operational Ecology Monitoring Program for Nuclear Plant 2 1985 Annual Report". Section 12.0 was the only section of this report provided by ENW, and the only section of this report that I reviewed.

Section 12 pertained to monitoring entrainment in the Columbia Generating Station (CGS) intakes and beach seine monitoring upstream and downstream of the CGS intakes. No entrainment was recorded in 1985 in weekly samples taken from April 3 to May 5, and again from July 23 to September 11.

Although this data suggests that no entrainment occurred during the testing, there are a few monitoring deficiencies to consider. First, there is only a rudimentary description and diagram of the entrainment capture cages. Flow was diverted through the intake screens from the river, and routed into the cages, which were rectangular boxes. No control release was reported, so presumably a control release was never conducted. This is unfortunate because the Chinook fry captured by seine net were small, with fork length ranging from 36-62 mm, with an average of 43 mm. Fry of this size are notoriously hard to recapture, especially in high velocity flow, because of their poor swimming ability and their propensity to seek refuge in calmer waters. From my review of mark recapture screen studies involving fry (see Appendix A), some portion of the control fish were never recaptured in nearly all or all of the studies - this does not mean they were not entrained, it only means they were never recovered. The number of control fish

[1] Washington Public Power Supply System, 1985. Operational Ecologcal Monitoring Program for Nuclear Plant 2, 1985 Report. Section 12. Prepared by Environmental Programs Department. WPPS, Richland, WA.

not recaptured was used to adjust estimates of mortality and injury. In the case of the CGS entrainment studies, there is no way to tell whether any or how many fish entrained from the river intake were captured in the cages.

Because the intake flow is low relative to the total river flow (Section 12 states 0.08%), the number of entrained fish would likely be low. If some fish were entrained, they could have been lost in the capture cage via poor seals, poor joints between mesh panels, mesh distortions, gaps at the closure gates or spillback of flow into the sump while the capture gate was open. If flow plunges from the pipe into the cage situated in a sump area of the intake, there is likely a portion of the cage's perimeter that is relatively quiescent beneath the impact of the plunge. Fish could potentially jump from the cage interior at the plunging flow and wind up undetected in the sump area. In addition, any gap in the cage larger than 1.75 mm could allow an escape path for fry. Without a detailed drawing of the capture cage, there is no way to assess whether escape paths were present. Without a pre-test inspection of the capture cage, there is no way to tell whether the design remained intact through the duration of the testing - a collision with the relatively fragile woven wire mesh could create an escape path. A mis-alignment of the capture cage with the intake pipe could also create an escape path for fish entrained at the CGS intake. Many of these physical deficiencies in the capture cages, whether real or potential, could have been corrected to account for escaped entrained fish if a control release were made to calibrate the efficiency of the capture cage.

With the relative flow amount so small, entrainment detection studies would need to be much more rigorous to capture any fish from the CGS intake.

Lastly, the size of the fish (36-62 mm) captured in the seine nets largely reflect the size of fish captured in an extensive spatial distribution study ("Spatial Distribution of Juvenile Salmonids in the Hanford Reach, Columbia River", Dennis D. Dauble, Page T.L. and Han Jr., R.W., U.S. Fishery Bulletin 87:775-790, May 1989) conducted near the CGS intake from July to September 1983, and again from April to June 1984. As demonstrated in my July 31, 2013, memo for Hydro Division files, the size of these fish makes them susceptible to entrainment at the CGS intakes.

2013 Coutant Memo [2]

I also reviewed a discussion paper titled "Why Cylindrical Screens in Flowing Water Impinge and Entrain Few Fish, and Its Importance for The Columbia Generating Station", authored by Charles C. Coutant, Ph.D. for Energy Northwest on November 7, 2013 (Report).

[2] Coutant, C.C. 2013. Why Cylindrical Screens in Flowing Water Impinge and Entrain Few Fish and its Importance for the Columbia Generating Station's Intake. Prepared by Charles C. Coutant for Energy Northwest, Richland Washington.

Dr. Coutant raises several points in his Report that are not entirely correct.

1) The Report interprets the results from a fish screen study at the Indian Point intake in the Eastern U.S. as providing unique insight as to how flow dynamics for a cylindrical screen (similar to the CGS screens) affect fish behavior around the screen to provide lower rates of entrainment as compared to screens that rely on approach velocity and screen opening size to exclude fish, which he implies is the basis of design for NMFS screen criteria. It is correct that flow dynamics in and around the screen face influence fish behavior, but incorrect in the assumption that this is not considered in NMFS screen design criteria. He is also incorrect in his assumption that this behavioral response is unique to cylindrical screens. In fact, each style of screen design currently in NMFS Design Manual (including cylindrical screens, which are a type of end of pipe screens, as described in NMFS 2011) relies partially on behavior to allow some fish to avoid the screen face entirely. Those fish that are incapable or do not behave to avoid the screen face (due to various combinations of flow anomalies, weak swimming ability, startle response etc.) are excluded from impingement by low approach velocity (Va) perpendicular to the screen face; are excluded from entrainment by small mesh openings; and are swept away from the screen by high sweep velocity (Vs) parallel to the screen face. This could partially explain why the Indian Point intake excluded around 90% of eggs, larvae and fry. A screen design to NMFS criteria typically excludes over 98% of Chinook fry, and sometimes up to 100%. It could well be that 90% of fish that encounter any style of screen (with a route of egress or bypass) are not entrained, and the remainder of the fish that are not entrained, impinged, killed or injured are protected by the mesh size and approach velocity. Regardless of the precise number, mesh openings that physically preclude a fish's body from entrainment both intuitively and factually increase the chance of survival.

2) It is stated in the Report that 3/8" pore size is common for fish screens. This is untrue in the Western Region, as Federal and state screen criteria are all identical to those specified in NMFS Design manual: 1.75 mm slots or 3/32" square or round opening size are called for where juvenile salmon are present. Nearly all (or possibly all) screen installations constructed after 1990 use this criterion.

3) It is stated in the Report that many screen sites with low debris load and high ambient river velocity do not need cleaning systems. This is a risky design in terms of fish protection and structural integrity, and is not the case in the Pacific Northwest except for very small screens (less than 3 cfs) with particular hydraulics. Debris load is often considered a minor issue by those inexperienced in screen design, and underestimating this issue in design has caused screen facilities to fail catastrophically. I note that a behavioral device tested by Dr. Coutant in the Cowlitz basin failed when debris accumulated and overwhelmed the facility rendering it ineffective and inoperable. It has since been removed.

4) It is claimed in the Report that due to a "bow wave" created by the design of a cylindrical screen, momentum moves particles away from a cylindrical screen's face, allowing water to enter and particles (such as fish) to be deflected away from the screen. This is true for any object in the path of water. The "bow wave" (called a null velocity point by hydraulic engineers) will vary depending on the shape of the object and the velocity of the flow around the object. What Dr. Coutant fails to point out regarding the figures in his report, is that the "bow wave" collapses after initiation, and the flow steamlines once again converge on the cylindrical screen face. The color contours in the Report Figure 1 show this clearly. This figure also highlights my point about the shape of the "bow wave" being dependent on flow velocity - the two modeled shapes in the Report's Figure 1 show low and high velocity flow fields around the same object. The collapse of the "bow wave" places any fish initially deflected by the nose cone, near the screen face and subject to entrainment, and this will vary with flow amount and river velocity. This also affects the ability of a screen face to rely on ambient velocity or sweeping velocity to shed debris, which is a primary factor for establishing a requirement for a screen cleaner.

5) Grant PUD, at two dams upstream of the CGS intake, often reports issues with large milfoil mats breaking loose near the end of summer. At dozens of fishway inspections, I personally conducted at these two dams, my inspection reports frequently point out debris accumulations that require removal by Grant PUD fishway attendants. The assertion in the Report that the Columbia River is relatively debris free is not accurate.

6) The Report states that "... at the test cylindrical screen, . . . entrainment prevention by these factors increase[s] with fish size.", referring to behavioral reactions to the "bow wave". Instead, I note that bigger fish have higher swim speeds, which allows them to swim away from the screen face and not be entrained. In addition, many types of fishes utilize hydraulic anomalies including null point or "bow waves" as velocity refuge to hold around natural or man-made objects. This behavior may extend the time period for fish exposed to the screen.

7) I also question the Report's assertion that eggs and larvae can exhibit any behavior to prevent them from being entrained, because generally they cannot swim.

8) The Report noted that juvenile salmon migrate downstream with their heads pointing upstream, which in many cases is true. However, at this site, many juvenile salmon are not migrating. Instead, they are rearing fish. As such, any assumption that tail first downstream migration impacts behavior due to lateral line detection of screen hydraulics is not accurate in a general case. In addition, it is not migratory juvenile salmon that are likely to be entrained through the 3/8" screen openings at the CGS intake because of their physical size. Instead, smaller rearing juvenile salmon - mostly Hanford Reach fall Chinook parr, but possibly some listed steelhead fry as well - would probably be wandering around the intake site foraging, and subject to entrainment at the CGS intake or to predation by piscivores taking advantage of the "bow wave" created by the CGS screen structure. However, I note that my recommendations for screen improvements at the CGS intake would not reduce predation potential.

9) The Report discusses baffle systems that are common on the East Coast to reduce entrainment through a water diversion, and makes a comparison to the CGS cylindrical screens, implying that fish behavior at baffle installations reduce entrainment. This is true enough for larger fish. However, we stopped using baffle systems on the West Coast because they entrain smaller fish when they are present.

10) The Report refers to an impingement study that shows no impingement. I question how valid this study could be, with only 9 hours of subjective observation in the past 30 years or so. If fish were impinged, predators or scavengers would likely remove any evidence. That said, I would not expect impingement of juvenile salmon to be observable at the CGS intake, because

small fish would be entrained not impinged, and larger fish could likely avoid impingement by behavioral reaction and swimming ability.

11) The Report implies that due to the "bow wave" shown in Figure 1, the CGS intake would not entrain fish. Figure 1 is a mathematical model based on some other screen site, and it may or may not be representative of the CGS screens.

12) The report generally concludes that "... there will be little vulnerability of migrating fish larger than about 20 mm (0.8 in.) to a porous cylindrical screen." Juvenile salmon smaller than about 90 mm are rarely migratory, and are present in the vicinity of the CGS intake. The vulnerability posed to juvenile salmonids from the CGS intake can be corrected to eliminate the potential of any juvenile salmon less than about 70 mm fork length to be sucked into the CGS intake as demonstrated in my previous file memo.

13) The Report misses another vulnerability for fish near the CGS intake posed when debris accumulates on the screen face, thereby reducing flow-through screen area and increasing screen approach velocity to the point where even larger fish could be impinged.

14) The Report misses yet another vulnerability to juvenile salmonids posed by occasional shallow depths over the CGS screens, which creates a higher velocity field on top of the screens. Since velocity equals flow divided by area, the higher velocity field is created when a smaller flow area results because of the narrower dimension between the top of the screen and the water surface, with the intake flow relatively unchanged as compared to a higher submergence. If a fish is caught in this higher velocity field above the screens at lower river elevations, the behavioral response aspect of fish protection is reduced, because the lateral line mostly or entirely cannot detect flow fields beneath the fish.

15) The Report states that emergent and "button-up" salmon and steelhead fry are unlikely to be present near the CGS intake because they are in the gravel, and further states that any juvenile salmon present are too large to be entrained through the 3/8" CGS screen openings (apparently

discarding the previous argument that fish behavior at a cylindrical screen precludes entrainment). This is weak, because clearly, at some point fry emerge from the gravel and would be subjected to the CGS intake. The spatial distribution study (Dauble, 1989 referenced earlier) clearly shows that juvenile salmon of size that could be entrained are present at the CGS site.

Appendix A - Selected screen and bypass studies in the Pacific Northwest

Bigelow, J.P. and R.R. Johnson. 1996. Estimates of Survival and Condition of Juvenile Salmonids passing Through the Downstream Migrant Fish Protection Facilities at Red Bluff Diversion Dam on the Sacramento River, Spring and Summer 1994. U.S. Fish and Wildlife Service Annual Report. North Central Valley Fish and Wildlife Office, Red Bluff, California

Hosey and Associates and Fish Management Consultants. 1988. Chandler Facility Evaluation. Prepared for U.S. Bureau of Reclamation, Contract No. 7-CS-10-07720, Boise, Idaho.

Hosey and Associates and Fish Management Consultants. 1990. Evaluation of the Chandler, Columbia, Roza and Easton Screening Facilities, Completion Report. Prepared for U.S. Bureau of Reclamation, Contract No. 7-CS-10-07720, Boise, Idaho.

Hosey and Associates and Fish Management Consultants. 1990. Easton Facility Evaluation. Prepared for U.S. Bureau of Reclamation, Contract No. 7-CS-10-07720, Boise, Idaho.

Johnson, R.C. 1995. Fish Passage Evaluation Tests in the North Shore Fishway Hydroelectric Project at The Dalles Dam. Prepared for North Wasco County People's Utility District, The Dalles, Oregon.

Knapp, S.M. (editor). 1992. Evaluation of the Juvenile Bypass and Adult Fish Passage Facilities at Water Diversions on the Umatilla River, Annual and Interim Progress Reports October 1990-September 1991. Project No. 89-024-01. Prepared for Bonneville Power Administration, Portland, Oregon.

Knapp, S.M. (editor). 1994. Evaluation of the Juvenile Bypass and Adult Fish Passage Facilities at Water Diversions on the Umatilla River, Annual Report 1993. Project No. 89-024-01. Prepared for Bonneville Power Administration, Portland, Oregon.

Mueller, R.P., C.S. Abernathy, and D.A. Neitzel. 1995. A Fisheries Evaluation of the Dryden Fish Screening Facility Annual Report 1994. Project No. 85-062. Prepared for Bonneville Power Administration, Portland, Oregon.

Nietzel, D.A., C.S. Abernathy, E.W. Lusty and L.A. Prohammer. 1985. A Fisheries Evaluation of the Sunnyside Canal Fish Screening Facilities Spring 1985 Annual Report. Contract No. DE-AC06-RLO. Prepared for Bonneville Power Administration, Portland, Oregon.

Nietzel, D.A., C.S. Abernathy and E.W. Lusty. 1990. A Fisheries Evaluation of the Westside Ditch and Wapato Canal Fish Screening Facilities Spring 1989 Annual Report. Project No. 85-62. Prepared for Bonneville Power Administration, Portland, Oregon.

Nigro, A.A. (editor). 1990. Evaluation of the Juvenile Bypass and Adult Fish Passage Facilities at Three Mile Dam, Umatilla River, Annual Progress Report October 1989. Project No. 89-024-01. Prepared for Bonneville Power Administration, Portland, Oregon.

Ruehle, T.E. and C.S. McCutcheon. 1994. PIT-Tag Studies with Juvenile Salmonids at the Chandler Fish Collection Facility, Yakima River, 1990. Project No.90-65. Prepared for Bonneville Power Administration, Portland, Oregon.