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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

May 16, 2011

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: FERC P-12495 Cascade Creek Hydroelectric Project
Draft License Application

Dear Secretary Bose:

The National Marine Fisheries Service (NMFS) has reviewed the Cascade Creek Hydroelectric Project (FERC No. 12495) License Application for Major Unconstructed Project, specifically Exhibit A the Project Description, the Hydrology Report, and the Aquatic Resources Report. The Project Description describes the project as consisting of a lake siphon at Swan Lake with a gatehouse and valve entry to an approximately three mile long 12-foot diameter tunnel complex of horizontal and vertical shafts. The power tunnel leads to a powerhouse at tidewater on Thomas Bay. An outlet control structure, a four to six-foot high weir or dam, will be used to store water up to six feet above the lowest elevation of the current lake outlet. Transmission would be a combination of overland and undersea cable to a point of connection at Petersburg, Alaska, approximately 15 miles to the southwest. A bypass reach would be created in Cascade Creek from the intake location at Swan Lake to tidewater. Transmission lines would consist of 2.7-miles of submarine transmission line in Thomas Bay, 4.6-miles of overhead transmission; 7.6-miles of submarine transmission line across Frederick Sound, and a final 3.6-mile transmission to Scow Bay substation.

NMFS is entrusted with federal jurisdiction over marine, estuarine, and anadromous fishery resources under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Anadromous Fish Conservation Act, and the Pacific Salmon Treaty Act. Section 305(b) of the MSA requires federal agencies to consult with NMFS on all actions that may adversely affect Essential Fish Habitat (EFH). If the proposed action would adversely affect EFH, NMFS is required to make EFH Conservation Recommendations, which may include measures to avoid, minimize, mitigate or otherwise offset adverse effects. Section 10(j) of the Federal Power Act (FPA) authorizes NMFS to recommend license conditions necessary to protect, mitigate damage to, and enhance fish and wildlife habitat affected by the project. Section 18 of the FPA provides NMFS authority to issue mandatory fishway prescriptions. In addition, NMFS has responsibilities related to FERC proceedings derived from the Fish and Wildlife Coordination Act, the Clean Water Act, the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA).

During consultation and scoping, state and federal resource agencies expressed concerns about hydrology relative to Swan Lake (primarily due to seasonal drawdown), Falls Lake (due to inflow changes and effects on lake level) and Cascade Creek (due to dewatering). Other potential project issues raised include effects on lake and stream water temperature regimes and effects of construction on water quality. Many of these issues were not adequately addressed during the scoping process. The Hydrology Report was not completed or made available for agency review until after the Scoping Document 2 (SD2) comments from agencies were due. Fisheries studies were either not completed, or were begun very late in the study season, yielding limited useful information for project impacts assessment.

NMFS review of the Project Description, Hydrology Report, and Aquatic Resources Report associated with the Draft License Application are presented below. NMFS also addresses Climate Variability and Long-term Considerations relative to this project.

Project Description

Project construction and operation details are incomplete and lack operating flow schedules, projected changes in timing and quantity of instream flow, estimates of effects of project operations on stream and lake habitat resources, effects on changes to instream flow and discharge into Thomas Bay on marine habitat, descriptions of lake level fluctuations, timing and magnitude, and rates of change. The resource management goal should be to limit the impacts of project construction and operations on marine and anadromous fish and habitat. Despite being described by the applicant as a "run-of-river" project, as currently described the Cascade Creek project has the capacity to increase storage in the lake and to draw down the lake, and thus it is not a "run-of-river" project.

The project description estimates the total generating capacity to be 70 MW. The project is described as having three 23.3 MW vertical shaft, five- jet impulse (Pelton) type turbines. "Each turbine will produce 31,246-hp at a gross head of 1,471-ft and a flow of 223-cfs" (p.7 Exhibit C). The ability to reach the proposed generating capacity is highly unlikely considering Swan Lake outflow estimates (Hydrology Report, Table 2) and lake elevations.

We estimated the power generating capacity of the project based on flow information from the Hydrology Report. Assuming a constant head of 1,471-feet and an efficiency of 0.9, without accounting for loss in head due to lake fluctuation or friction loss, in a typical water year using all surface flow we estimate that maximum production would occur in July and be approximately 19MW. During winter months, considering the lower flows available at that time of year the capacity would be closer to 1MW. These estimates represent best-case scenarios and exclude water that will likely be required for environmental needs including lake level management, minimum streamflows, and maintenance of fish passage.

The applicant should recalculate the project's generating capacity using realistic estimates of the water available for generation under current project design specifications and flow conditions.

Hydrology Report

In addition to the estimates of power production as a "run-of-river" project, we have some concerns about the hydrology data and associated conclusions presented in the Hydrology

Report. Our initial concern is the timing in the licensing process that this data and information was made available. This information should have been provided prior to, or with Scoping Document 1 (SD1) but was only recently made available for agency review with inadequate time for thorough review.

The quality of the streamflow data and estimates of lake levels are inadequate to determine the effects of project operations on available habitat. The stage discharge relationships are inadequate for developing rating curves and could result in potentially erroneous streamflow records. Stage discharge relationships for natural channels should be developed empirically through repeated stage and flow measurements. Proper rating curve development requires compensation for gauge datum to river bed distance, selection and partitioning of gauging measurements according to underlying flow conditions, and accounting for differing flow control conditions. A rating needs to allow for temporary compensation or shifting of the stage vs. discharge relation to maintain accuracy during changing conditions such as icing or increased vegetation. The accuracy of calculated flow values depends on the accuracy of rating curve transformation. The description of the gauges in the appendix is very detailed, including descriptions of the controls, points of zero flow, and streamflow collection methods and equipment. This information was very helpful in reviewing each rating. In Appendix A some of the measurements are described in detail but this is inconsistent. When available, measurement conditions and quality provide useful information but this information is not represented in the rating development.

The Cascade Creek near Petersburg rating utilizes three measurement points from 1918 and four additional points from 2009 to the present. One of the points from 1918 used in the rating development is a ~5.6ft stage and 975 cfs flow, but this is the lone point on the upper end of the rating curve and the clear reason that the rating has a high R^2 value. Using all of this data on one rating, with no shifts, and no mention of point of zero flow measurement, assumes that the cross-section has not changed, that the ice, debris, scour/deposition conditions were all the same during all of the measurements. The rating points should be re-examined, without the 1918 data, and with a point of zero flow. Likely, more measurement will be needed to solidify the rating and guage record.

The rating for Falls Creek has six measurements and the rating is segmented as power functions connecting each of the point measurements without explanation. Are there really control changes at each of these power function changes? The information in the Hydrology Report does not support this rating and it may be possible to develop a simpler rating. The rating should be reexamined by the conditions of each flow measurement (time of year, ice, scour, deposition period, debris). The streamflow discharge relationship should also be reexamined without the December 19, 2009, flow (probably ice influenced) from the base rating development. We also recommend analyzing the 2009 and 2010 data separately to see if there was a major control shift between these years. Often in steep and wooded streams controls (and thus the rating) can change drastically year to year. After reexamination of the data, a base rating and trend may justify shifts to a base rating, or more measurement may be needed to develop this base rating.

On page 17 the continuity equation presented does not include an error term, so in reality the calculated seepage term includes the seepage and error associated with all other measurements, and so seepage estimates are likely to be inaccurate. One of the conclusions from the water budget modeling is that a *higher contribution of seepage occurs during the winter months, when lake levels are low and surface water inflows are at their lowest*. This should probably say that the ratio or proportion of the seepage to the entire water budget during winter months is higher due to it being a low flow period, rather than imply that winter inflows are high. Likely the highest magnitude of seepage flow (and the lowest ratio of seepage flow) occurs during the highest flow periods, as the hydraulic gradient and area covered by water will be at the highest point then as well. This concept is stated correctly later in the paragraph when discussing seepage during high flow.

In Section 8 (p. 18) Table 1 includes measured Lower Cascade Creek flows, estimates of Swan Lake outlet surface flow, estimated Swan Lake total flow (including seepage), and the Swan Lake outlet measured surface flow (period of record 1/20/2010 to 10/26/2010). The estimates of Swan Lake outlet flows are based on a regression between the lower guage and lake during the recent period of record. Estimated values of lake outflow do not compare well with the period of record of measured outlet flows; the estimated flows are ~20% less than the measured flows. More explanation is needed here to justify the use of the Swan Lake Estimated Outlet flows. Page 13 of the Hydrology Report notes "the rating curve for lower Cascade Creek flow as a function stage in Falls Lake was used as the basis for estimates of historic lake levels in Falls Lake. Stage in Falls Lake was calculated directly from historical flows in lower Cascade Creek to estimate the corresponding historic lake levels for Falls Lake." We recommend providing additional justification here as well.

In Section 9 of the Hydrology Report, the text under Swan Lake Stage and Flow-duration Characteristics relies heavily on the described relationship between Swan Lake levels and Cascade Creek flows. The conclusions derived from Section 9 state that average annual minimum lake elevation is at an elevation of 1,511 feet annual-mean-sea-level (amsl), and that the maximum lake elevation is 1,517.4 feet amsl, equating to an average annual fluctuation of 5.8 feet. How does this compare to actual lake level measurements? The actual measurements of lake level, tied to amsl, should be presented on Figure 14. An error term should be included in the lake level estimates. Likely the error is greater than 1/10th of a foot. Also in Figure 15 the actual measured lake level data should be presented with the synthesized duration curves.

Aquatic Resources Report

In the Aquatic Resources Study Plan, Cascade Creek LLC proposes studies of Swan Lake and tributaries; Upper Cascade Creek and tributaries; Falls Lake; and lower Cascade Creek to tidewater. The purpose is to describe pre-development aquatic resource baseline conditions in order to estimate the potential effects of hydroelectric power development and proposed project operations on these resources. These studies should be conducted over more than one season and be completed prior to project licensing. The studies should include: stock assessment and seasonal fisheries inventory; fish habitat survey; geomorphology of Swan Lake inlet; Falls Lake bathymetry; littoral zone of Falls Lake; limnology of Swan Lake at the proposed penstock intake location; and aquatic macroinvertebrate study of Falls Lake and Lower Cascade Creek. Upon further review and consultation with the Alaska Department of Fish & Game, NMFS concludes that the methods, timing, and longevity of the currently disclosed studies are insufficient for assessing project effects on aquatic resources and for developing conservation recommendations.

The current information about spawning and habitat utilization is inadequate to make effective conservation recommendations absent spawning and habitat utilization studies in the anadromous reach. NMFS again requests analysis of the effects this project on aquatic resources in Thomas Bay and Frederick Sound associated with the proposed transmission route, including submarine transmission cables. The planned studies should be completed prior to project licensing. Delays in study planning, initiation and completion have prevented NMFS from obtaining information necessary to determine project effects on aquatic resources that are necessary for developing conservation recommendations as provided for in section 10(j) of the FPA.

Section 6.2 of SD-2 states that all guages were installed prior to the end of December 2009, but the quality of the data, rating control, and number of rating points is unknown. During a September 28, 2010 meeting to update agencies, Cascade Creek LLC stated that the minimum flow in Cascade Creek, presumably at the mouth, was 150 cfs, and pointed out that portions of Cascade Creek would flow through coarse substrate interstitial spaces, not at the surface. Without being provided currently available flow data and with a very short record it is unclear if the current instream flow patterns are consistent with historic USGS flow records. The existence of low flows in September 2010 that are more than 300 cfs less than the historic mean values at this location, with recorded dry reaches in Cascade Creek, further demonstrates the need for more hydrologic information. From existing information it is unclear how project operation might contribute to passage barriers associated with dewatering in the bypass reach.

NMFS typically recommends continuous stream flow gauging in the anadromous reach for a minimum of five years to adequately characterize the stream flow and allow for extrapolation of flow records from proxy sites with long term stream gauge records or use of other methods of estimating long term stream flow. Cascade Creek LLC provided fifteen years of instream flow data at the mouth of Cascade Creek, from 1959 to 1972. This data set is informative but insufficient to represent current conditions, and no current instream flow data is presented in SD-2. Current and relevant in-stream flow data and habitat information, locations of the tailrace discharge area, and ramping rates are needed to design adequate instream flow requirements for the anadromous reach.

Climate Variability and Long-term Considerations

Planning for new hydro projects has in the past relied on the assumption that future air temperature and precipitation patterns would be the same as those in the past. Given the increasing certainty of global climate change, this assumption is no longer valid. Further, hydroelectric project operations depend not only on large-scale, long-term climate predictions, but also estimates of seasonal air temperature variation as it affects electrical load, streamflow, snowpack, and rainfall. With needs to predict both quantity and timing of precipitation and temperature in an uncertain future, planning for new projects should analyze long-term (multi-decadal) climate and hydrology datasets and assess downscaled climate projections, while recognizing the limitations of these data and models.

Climate models project annual warming of three to four degrees Celsius over the 21st century for southeast Alaska and a five to eight percent increase in annual precipitation, with a significant shift from snow to rain. Increases in runoff are expected to exceed increases in precipitation in basins with glaciers as those glaciers melt, but not after they have receded entirely. Analysis of historical data show that approximately half of the observed warming in southeast Alaska since 1920 is attributable to the variability of the Pacific Decadal Oscillation, a naturally occurring mode. This pattern of climate variability drives persistence of temperature and precipitation anomalies in such a way that hydropower utilities developers and managers should anticipate the possibility of 'non-normal' inflows for an entire decade or longer, as part of natural variability. On top of this decadal persistence are the long-term trends associated with global climate change: warming and wetting (Cherry, et. al. 2010).

From an environmental standpoint, misestimates can result in unmet instream flow requirements for fish, unexpected low reservoir levels, and water quality and quantity conditions affecting such diverse resources as recreation, aesthetics, subsistence, and tourism, among others. From an economic standpoint, misestimates can result in less reliable electrical generation, more diesel fuel consumption, higher energy costs, and a host of other negative factors. NMFS anticipates that additional discussions with the applicant will be necessary to develop the climate monitoring and assessment necessary for Cascade Creek prior to the Final License Application.

Relative to Climate Variability and Change NMFS recommends that evaluation for the Cascade Creek hydroelectric project include analysis of how anticipated changes in temperature and precipitation can be expected to impact the operations, efficiency and longevity of the proposed hydropower project. This could include the following analysis:

1. The impact of climate variability on precipitation, temperature, snow pack, and river discharge.

   Natural climate variability in Alaska is influenced by the El Niño-Southern Oscillation (ENSO), the Arctic Oscillation, and the Pacific Decadal Oscillation. The seasonal prediction models available may be of value for management of reservoir levels. Direct analysis of historical variability in climate parameters for the proposed watershed will assist in projections for water level, energy output and project longevity. Reconstruction techniques can also be used to infer whether longer scales of variability may be relevant to the proposed lifespan of the project.

2. Projections of climate impacts over the lifespan of the project.

   These would include 100-year or longer projections of temperature and precipitation distributions for the watershed under various scenarios of global greenhouse gas emissions. Also included should be a projection of likely changes in soil temperatures, permafrost distributions, and associated impacts on sub-surface water storage.

3. Changes in glacial systems and their impacts on watershed hydrology.

Changes in glacial systems are complex because they are driven by changes in both temperature and precipitation. Southeast Alaska is generally projected to warm but is near the boundary where snowfall is expected to decrease and where it is expected to increase. Climate-glacial interactions should be explored in more depth, as they apply to this region.

Conclusion

In summary, the information in the Project Description, Hydrology Report, and Aquatic Resources Report is deficient. We find estimates of 70MW far exceed the project's potential generating capacity, which we estimate to range from 1MW during winter low flows to a peak monthly maximum of 19MW during summer high flow conditions. Without a better understanding of the basin hydrology, lake level fluctuation, aquatic habitat, and species in Swan Lake, Cascade Creek and associated tributaries, habitat at the mouth of Cascade Creek, as well as parts of Thomas Bay and Frederick Sound, as well as greater detail about project operations, we cannot adequately determine the impacts to NMFS trust species or provide recommendations. Cascade Creek should analyze long-term (multi-decadal) climate and hydrology datasets and assess downscaled climate projections in order to plan for this long-lived hydroelectric project in a location of changing climate. This information is necessary for NMFS to make effective conservation recommendations relative to the protection, mitigation, and enhancement of fish and wildlife resources that may be impacted by the project per Section 10(j) of the FPA.

NMFS looks forward to further discussion concerning this project. Please contact Susan Walker at (907) 586-7646 (susan.walker@noaa.gov) or Eric Rothwell at (907) 271-1937 (eric.rothwell@noaa.gov) with any questions regarding this project review.

Sincerely,

Robert D Mecum

for James W. Balsiger, Ph.D.
Administrator, Alaska Region

Cherry, J. E., S. Walker, N. Fresco, S. Trainor, and A. Tidwewll. 2010. Impacts of climate change and variability on hydropower in Southeast Alaska: Planning for a robust energy future. International Arctic Research Center and Institute ofNorthern Engineering, University of Alaska, Fairbanks. 28 pp.

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Document Content(s)