Alaska Energy Cost Reduction Program
Progress Report

Grantee: Alaska Power & Telephone Company (AP&T)

Grant Contact # UAF 10-0054

Period of Report: Third Quarter 2011 (July 1 through September 30, 2011)

Project Name: Yukon River Hydrokinetic Project

Quarterly project activities completed:

Background: During the second quarter after advising ACEP of the economic status of the project AP&T in conjunction with ACEP developed a plan for the redeployment of the turbine equipment at the AHERC Tanana River Test Site in Nenana to continue the turbine study. The plan was drafted and submitted to the Denali Commission. After a thorough review process the Commission, in May, issued Award Number 01198-01 to UAF ACEP. This award is an amendment of the original award granted to AP&T and makes UAF ACEP the recipient of the balance of the funds available from the original award. Following the one to two year studies at Nenana the equipment will be returned to AP&T and the future disposition of the equipment will be determined.

The project equipment was removed from Eagle and transported to Fairbanks, AK and stored in ACEP/UAF facilities until spring 2012 deployment to AHERC Nenana, AK facility.

The turbine is being repaired at the ABS shop in Fairbanks, AK. During discussions with the turbine manufacturer New Energy Corp. it was decided that the turbine would be shipped back to the factory for evaluation and repair.

Project existing or potential problems:

The project equipment is now in storage and/or is in the process of inspection and repair at the suppliers facilities. There are no additional problems to report at this time.

Activities Targeted for Next Reporting Period, Fourth Quarter 2011:

Support of the ongoing ACEP studies

UAF School of Fish
Q3 2011 Report to AP&T

Fish sampling was continued during the reporting period until 28 August 2011 in the Tanana River near Nenana, Alaska in order to characterize the downstream migration of juvenile fishes. Sampling occurred in two primary river habitats, the river margins and river mid-channel. Fyke nets designed to catch down-migrating juvenile fishes were our primary river margin sampling gear. An incline plane trap designed to catch down-migrating juvenile fishes in the top 42" of the water column was our primary mid-channel sampling gear. In addition to collecting data on the juvenile fish community, we continued to measure a suite of environmental variables including water temperature, water velocity, turbidity, and river surface debris.

From 1 July 2011 to 28 August 2011, we made a total of 225 fyke net sets totaling 113 hours of soak time capturing 1,068 juvenile fish (Table 1).

Table 1. Total number of fish captured of each species on the river margins with fyke nets in the Tanana River at Nenana, AK from 1 July 2011 to 28 August 2011.

Species	Total Number Captured
Arctic Grayling	19
Burbot	14
Chum Salmon	9
Coho/Chinook Salmon	2
Lake Chub	280
Arctic lamprey	41
Longnose Sucker	292
Whitefish sp.	411

From 1 July 2011 to 28 August 2011, we made a total of 25 sets with the incline plane trap totaling 22 hours of soak time capturing 1 Arctic lamprey.

In addition to sampling the river margins and the top 42" of the river mid-channel, we successfully developed a new method to sample the bottom of the water column in the mid-channel using a modified frame trawl. To accomplish this sampling on the bottom of the river channel, we deployed a 4 ft. x 4 ft. frame trawl from a modified 10 ft. by 20 ft. aluminum pontoon barge loaned to us by the Yukon River Inter-tribal Watershed Council. Modifications of the pontoon barge included two 8,000 lb. winches and one 1,000 lb. capstan winch, a flat solid deck for a working surface and a re-configured aluminum railing system to accommodate pulleys and supports for our sampling gear. However, due to challenges in sampling in the middle of the river that caused several delays, we had limited sampling with this method. A total of four mid-channel bottom sets and two surface mid-channel sets were made, totaling one hour of soak time, capturing no fish.

Since the completion of sampling at the end of August, fish sampling data has been in the process of being analyzed by Parker Bradley as part of his master's thesis at the UAF School of Fisheries and Ocean Sciences. During the next quarter, Parker will continue data analysis to describe trends and patterns of catches in the Tanana River. He will be submitting a completion report in November to interested parties describing fish sampling results.

Alaska Hydrokinetic Energy Research Center
Q3 2011 Report to AP&T

Introduction

The debris mitigation and fish sampling project started in 2011 (May 1, 2001) to support Alaska Power and Telephone's (AP&T) efforts to use hydrokinetic power generation as part of their portfolio of energy sources. In 2010, AP&T conducted a hydrokinetic power generation demonstration project at Eagle, Alaska that was severely impacted by floating and submerged debris. The debris created safety issues and limited the amount of power that could be generated by the hydrokinetic turbine. This experience made it clear that methods and technology to mitigate the adverse effects of debris on hydrokinetic turbines were needed before power from hydrokinetic turbines could be generated in a sustainable way. To address this issue, AP&T, the Alaska Hydrokinetic Energy Research Center (AHERC), and the Denali commission agreed to rescope the AP&T project to address the issue of developing methods and technology to mitigate the effect of surface and near-surface debris on hydrokinetic turbine operations. In addition to the debris problem the rescoped project continued the fish characterization study started by the UAF School of Fisheries and Ocean Sciences (SFOS). The debris mitigation study is being conducted at the AHERC test site on the Tanana River at Nenana, Alaska. The fish study was moved from the Yukon River at Eagle, Alaska, to the Nenana test site. The quarterly report for the fish study is being reported separately from this report by SFOS and won't be further discussed except as it relates to the debris mitigation work.

For the debris mitigation part of this project we developed the following goals:

(1) Develop a test debris mitigation platform that will allow us to test various debris mitigation technologies and methods.
(2) Prepare the Nenana test site infrastructure (e.g., anchoring/mooring system) to be able to accommodate the debris mitigation platform tests and possibly retest the New Energy Turbine, as appropriate.
(3) Obtain necessary permits and conduct the necessary baseline studies to prepare for the debris mitigation testing.
(4) Conduct the debris mitigation technology and debris management methods testing.

Current activities and progress

During the current quarter (we include May and June activities in the current quarter). We have been able to leverage some of the Eagle Hydrokinetic Project work with our Alaska Energy Authority (AEA) funded Nenana Construction Project as both projects have similar goals related to characterizing debris and fish. In June we purchased and installed an anchor mid-channel in the Tanana River at Nenana for purposes of allowing fish sampling and to use as an anchor for later studies (Figure 1). We also attached a mooring buoy to the anchor chain to make it easy to attach and detach additional floating platforms (e.g., fishing platforms, debris mitigation devices, turbine platforms). Fishing operations to determine baseline fish populations and conditions were

conducted by SFOS from the mooring buoy from June through most of September as part of our permit to conduct work and in preparation for future studies.

In mid-September, preparations were made to remove the mid channel mooring buoy from the Tanana River at the end of the open water season. Chain handling hardware was requisitioned to facilitate the buoy removal. Buoy removal strategy was discussed with a local tug and barge operator who anticipated being able to assist in the operation in early October.

The AHERC staff performed monthly sampling of the Tanana River at Nenana in May, June, July, August and September as part of their AEA project that provides river characterization data that will benefit project efforts to conduct and analyze debris diversion tests next season. Sampling consisted of performing river velocity transects, river slope, bed-load sediment sampling and suspended sediment sampling. The calibration of the local river stage logging system was checked in June, July and September.

A generator powered debris video recording system was developed and installed on the banks of the Tanana River at Nenana to monitor surface debris on August 24 and was scheduled to operate for four days, the limit of its endurance without refueling. The system was pointed in the general direction of the mooring buoy at the location shown in Figure 1. The debris monitoring system will be improved and used next season to further characterize debris on the Tanana and to monitor the performance of our test debris mitigation technology.

A major effort this quarter was to develop a concept of what the debris mitigation test system should look like as a first step toward developing a specific engineering design. The concept debris mitigation test system is shown in Figure 2. It consists of a drag embedment anchor (installed this past summer), a mooring buoy (a first generation buoy was designed and tested this year and a second generation buoy is under development), the debris test platform, and any platform that is to be protected form debris (e.g., the hydrokinetic turbine. Our concept for the debris test platform was developed using lessons learned from the experiences of the Yukon River Intertribal Watershed Council (YRITWC) and AP&T's turbine deployments on the Yukon River at Ruby and Eagle and from an extensive literature survey that AHERC conducted.

The debris test platform design includes two rectangular pontoons joined at one end to form an angle. The angle will be adjustable to allow tests of the efficiency of clearing debris from the pontoons as a function of pontoon apex angle. The power of sweeping debris parallel to the pontoon varies as $[V\cos(\theta/2)]^3$ where V is the current speed and θ is the apex angle. The power of pinning debris against the pontoon surface varies as $[V\sin(\theta/2)]^3$. This means that a smaller apex angle should greatly improve the force to sweep debris along the pontoon surface and also significantly reduce the force of debris acting perpendicular to the pontoon (a condition that can force debris under the pontoon). In front of the pontoons apex angle is a segmented debris roller that is freely rotating (shown as a circle on the debris diversion device in Figure 2) that minimizes the ability of debris to catch on the front angle of the diversion platform. The platform will have decking on the pontoons and a catwalk that can be extended forward of the platform to allow safe removal of any debris that accumulates. Added safety features include quick release brackets that will allow the user to disconnect the platform under load if extreme conditions should occur.

Planned activities for the next quarter

For the next quarter we plan to finalize our conceptual design and begin developing an engineering design of the research debris diversion platform to guide construction of the diversion platform. We will conduct a design review with AP&T prior to beginning construction. Once the engineering design is approved we will begin construction of the debris diversion platform. Other activities will include designing a new mooring buoy with the idea of testing its ability to deflect submerged debris during the 2012 open water season..

Figure 1. Approximate location of anchor system in the Tanana River at Nenana, Alaska.

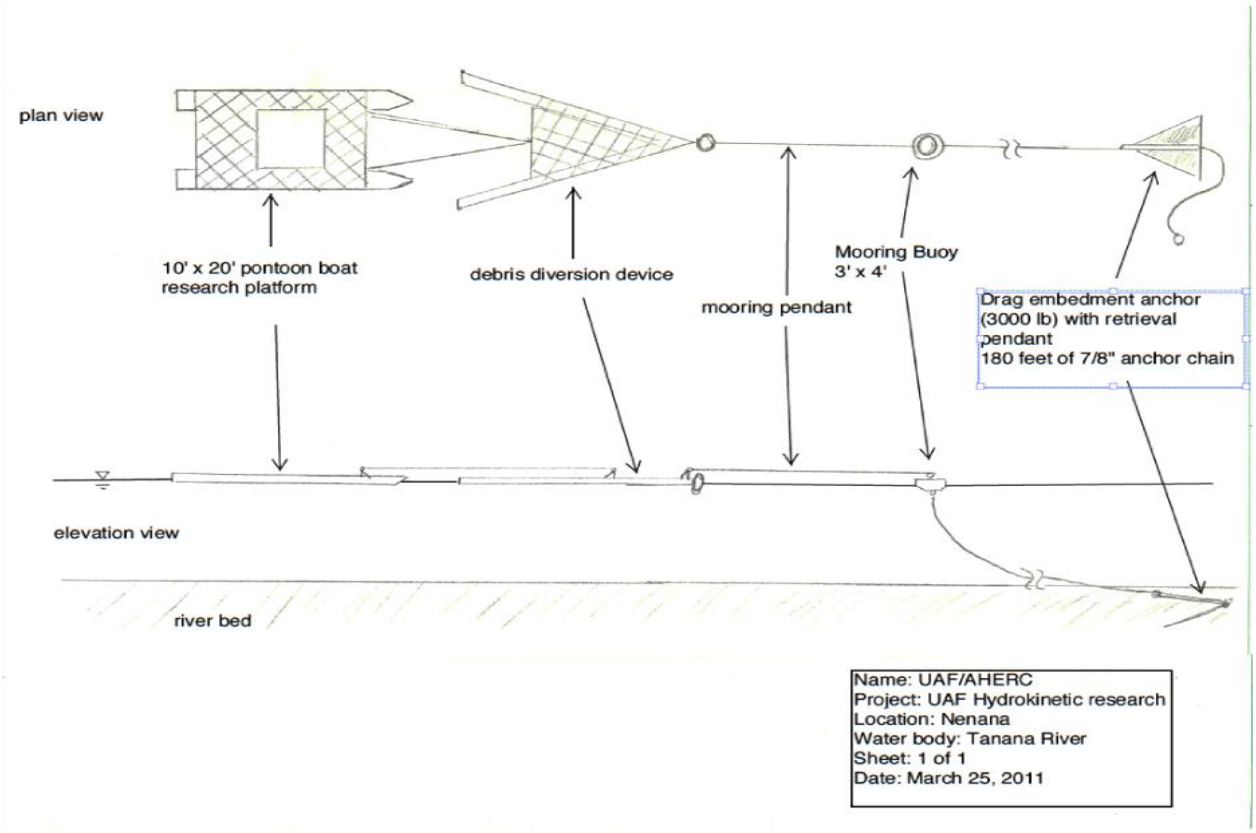

Figure 2. Plan and elevation views of the conceptual debris diverstion testing system consisting of a drag embedment anchor, a Mooring Buoy, debris diversion test platform, and possible hydrokinetic turbine device.