99E-105

4.5 PSP Cover Sheet (Attach to the front of each proposal)

Proposal Title: Bay Delta Crab Control
Applicant Name: Aquallife Electrical Barriers Inc.
Mailing Address: P.O. Box 13-313 Plam Springs, CA. 92255
Telephone: (760) 349-0075
Fax: (760) 349-0017
Email: H2Oscren@gte.net

Amount of funding requested: $ 154,489.00 for 1 years

Indicate the Topic for which you are applying (check only one box).

- ☐ Fish Passage/Fish Screens
- ☐ Habitat Restoration
- ☐ Local Watershed Stewardship
- ☐ Water Quality
- ☒ Introduced Species
- ☐ Fish Management/Hatchery
- ☐ Environmental Education

Does the proposal address a specified Focused Action? X yes _____ no

What county or counties is the project located in? N/A

Indicate the geographic area of your proposal (check only one box):

- ☐ Sacramento River Mainstem
- ☐ Sacramento Trib: _____
- ☐ San Joaquin River Mainstem
- ☐ San Joaquin Trib: _____
- ☒ Delta: _____
- ☐ East Side Trib: _____
- ☐ Suisun Marsh and Bay
- ☐ North Bay/South Bay: _____
- ☐ Landscape (entire Bay-Delta watershed)
- ☐ Other: _____

Indicate the primary species which the proposal addresses (check all that apply):

- ☐ San Joaquin and East-side Delta tributaries fall-run chinook salmon
- ☐ Winter-run chinook salmon
- ☐ Late-fall run chinook salmon
- ☐ Delta smelt
- ☐ Splittail
- ☐ Green sturgeon
- ☐ Migratory birds
- ☐ Other: _____
- ☐ Spring-run chinook salmon
- ☐ Fall-run chinook salmon
- ☐ Longfin smelt
- ☐ Steelhead trout
- ☐ Striped bass
- ☐ All chinook species
- ☐ All anadromous salmonids

Specify the ERP strategic objective and target (s) that the project addresses. Include page numbers from January 1999 version of ERP Volume I and II:

_____

_____

_____

Indicate the type of applicant (check only one box):

☐	State agency	☐	Federal agency
☐	Public/Non-profit joint venture	☐	Non-profit
☐	Local government/district	☒	Private party
☐	University	☐	Other: _____

Indicate the type of project (check only one box):

☐	Planning	☐	Implementation
☐	Monitoring	☐	Education
☒	Research		

By signing below, the applicant declares the following:

1.) The truthfulness of all representations in their proposal;

2.) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and

3.) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Donn Moore

Printed name of applicant

Signature of applicant

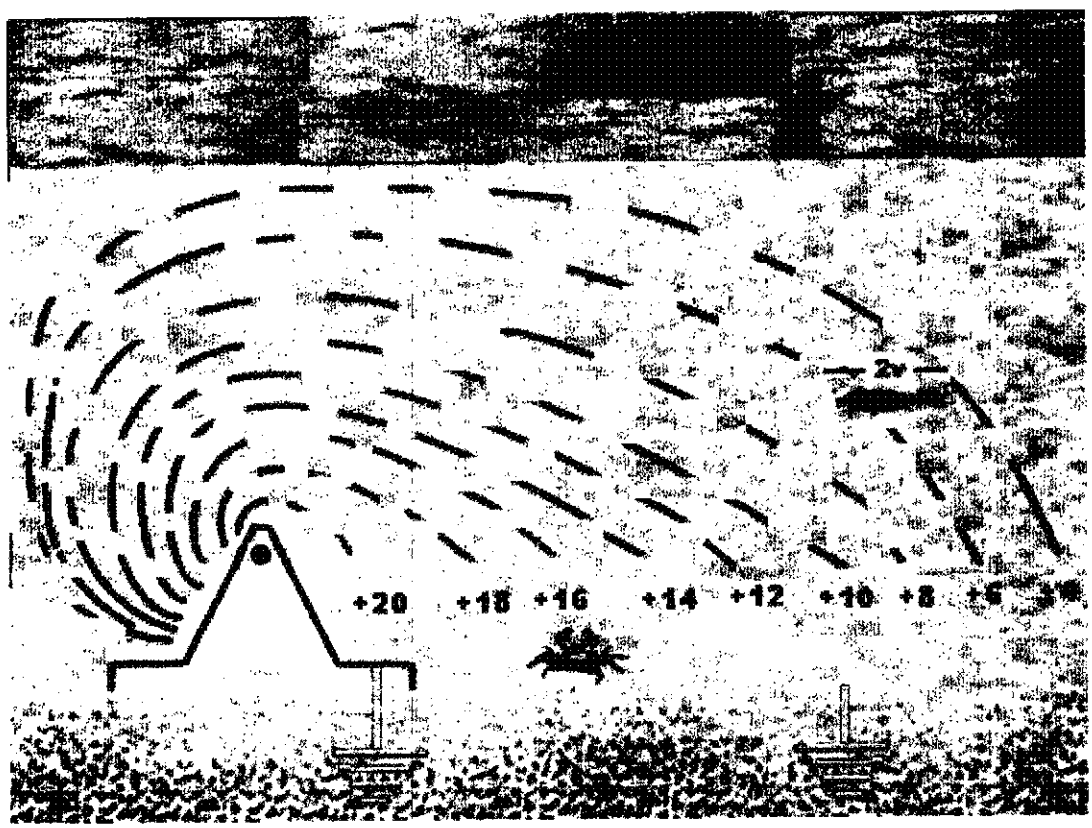
I-019767

Executive Summary

The application of the Aqualife Electrical Barrier to trap or detour Chinese Mitten Crabs is applicable to the entire Bay Delta region. The ability of the AEB system to accomplish this task was demonstrated at the Bureau of Reclamation's site in Denver Colorado. Over three days, changes to the barrier brought the system to 100% effectiveness. The desirability of removing migrating adults and juveniles from the ecosystem need not be recounted here. The fact that the crabs deliver them selves to the trap unharmed points to the use of this system if a fishery is ever approved for the crabs.

The AEB electronic barrier that has been designed to control crabs has advantages over all other type barriers. Positive barriers do not provide for the free passage of fish and can be clogged by crabs. Mechanical barriers, such as traveling screens, have an effect on fish, can not be easily moved to a new problem location. They will cost 10 to 100 times (per linear foot) than the AEB barrier. Most of the mechanical traps that depend on gravity will silt up, tend to be of the permanent type and may not be easily moved.

The AEB Crab Barrier takes advantage of the fact that the crab walks on the ground plane or negative electrode. This fact permits the power supplies to be operated at a level much lower than is needed to control fish. Fish are not grounded and only feel the voltage differential from nose to tail. The smaller the fish, less differential voltage is applied.



The size of the population of Mitten Crabs is largely being extrapolated from the collections made at the Bureau's Tracy facility and DWR's Skinner location. Both these facilities share common waterways that are a small part of the Bay Delta. The direction of the migration suggests that neither, magnetic direction or the sensing of brackish water was involved. The crabs simply put the water flow at their backs and head down stream. DWR has found the crabs as far south as the Cross Valley Canal. The Mitten Crabs found in the system are probably the result of juveniles being pumped up from the Skinner facility to Bethany Reservoir. With places like the O'Neill Forebay nurture them, they simply will head south when they mature. If we are on the beginning of the 15-year cycle suggested by Stephan Gollasch at the Chinese Mitten Crab Workshop last March; the problems will show up in other locations this fall. Places like SMUD's intake at SRWTP and FWTP that have positive barriers could easily jammed by a mass of migrating crabs. Until more accurate numbers and locations of crabs are developed, the need for a rapidly deployable barrier is obvious. The barrier can also assist in making population and location assessments

Several groups that have seen the videos taken of the Denver experiment, have felt that the electrical barrier could be of use in mitigating the presents of the other Bay Delta NIS crab species, the Green Crab. Since the Green Crab does not have the migrating habits of the Mitten Crab, the first use of the barrier would be to keep them out of commercial clam and oyster beds. The Hog Island Oyster Company in Tomales Bay being a case in point. By continued study of the Green Crab, some habit not yet known, may lead to a method of trapping them for removal from the ecosystem. The barrier can also be used for collecting specimens.

The only thing that stands in the way of taking these positive steps is the approval of the barriers by CDF&G, USFWS, and NMFS. The details of how this will be accomplished will be shown in the following section.

This proactive plan will take one year to complete at a cost of $154,489.00. The timing of tasks that are in the critical path to the first milestone, are organized so that conditional approval could be granted by CDF&G, USFWS and NMFS before the fall migration starts. This will allow an orderly deployment of barriers rather than from desperation as facilities and systems are over run.

Project Description

Electric screens and barriers have been used over the last 50 years with varying degrees of results. Alternating Current (AC) screens killed fish and were a danger to humans. Direct Current (DC) models tend to attract fish in front of the positive electrode (anadotical attraction), making them easy targets for predators. If fish were swept or chased into the stronger field near the electrodes, they were stunned or killed.

The AEB barrier uses pulsed DC as a *deterrent*. The AEB electronics are configured to have a very short pulse or duty cycle. In fact there is no electrical field for 99.935% of the time. These short pluses warn the fish not to come closer but in no way harm the fish in the event that they are chased or swept over the electrodes.

Comparisons of any older system to AEB's system would not be productive, as most of the key electrical components used in AEB's system were not available 3 years ago.

The Bureau of Reclamation in Denver has offered AEB the use of the Tracy flume to develop a trash and Egeria resistant barrier.

Considerations

- The water hyacinth is more of a surface menace and is **not** considered a problem.
- The pattern of the field forming arrays will be tested and voltage gradients will be recorded. The barrier design showing the most effective voltage gradient pattern combined with the best characteristics for low silt buildup, weed and trash shedding will be selected for additional testing.
- To evaluate the effects of the electrical barrier on non-target fish species, experimental laboratory studies are frequently conducted.

Phase One Testing

The basic objectives and hypotheses for experimental tests include:

- Passage of fish through the electrical field will **not** result in significant incremental acute mortality.
- The presence of the electrical field will **not** result in significant behavioral changes resulting in delayed passage, swimming fatigue, increased stress or increased vulnerability to predation.
- Passage through the electrical field will **not** result in significant increases in sub-lethal stress which, in combination with handling associated with salvage, results in significant cumulative reductions in the survival of salvaged fish.

Experimental studies to evaluate these potential issues will be targeted on juvenile life stages of sensitive species, particularly those listed for protection under the ESA. For purposes of experimentation it may not be possible to actually test the effects of the electrical barrier on listed species and hence surrogate species may need to be tested. Potential target species would include:

Target Species	Surrogate Species
Winter & Spring Run Chinook Salmon	Juvenile Fall-Run Chinook Salmon
Juvenile Steelhead Trout	Juvenile Resident Rainbow Trout
Splittail	Golden Shiner
Delta Smelt	Inland Silverside or Wakasagi

In the event that surrogate species are used for testing, it will be important that the experimental design be critically reviewed to obtain concurrence that the results of such tests will be appropriate. The following Departments would include but are not limited to representatives of:

- California Department of Fish and Game
- U.S. Fish and Wildlife Service
- National Marine Fisheries Service

Experimental Test Design

The experimental tests should be designed in such a way to allow for the acclimatization and release of test fish upstream of the electrical barrier, with recaptured fish downstream. The facility should represent, to the maximum extent possible, the water velocities occurring in applicable sites. A typical experimental design would include:

- The release of 5 groups of 10 fish each (same species) as replicates during a period when the electrical barrier is **on** and 5 replicate tests utilizing 10 fish each when the electrical barrier is **off**.
- This study would be performed separately for each of the target species. Testing of "Barrier On" and "Barrier Off" conditions would be randomized.
- Resulting data collected would be analyzed using a T Test, ANOVA, Chi-square, or other appropriate statistics.
- The duration of each test would be approximately 30 minutes or until all of the released fish had passed downstream of the electrical barrier.
- The fish would be acclimated in the experimental chamber (within the holding device) for a period of approximately 2-4 hours prior to release to reduce the effects of handling stress.
- Fish would be held at the site of the experimental test in water having comparable water quality and temperature characteristics as that being used in the tests.

Test Measurements

Test Measurements would include:

- The elapsed time between release and passage of each individual fish through the electrical array (transit time)
- The orientation of each fish during passage through the array, and qualitative observations of the behavioral response to fish at the array.
- The number of fish within each test group passing through the array during the 30-minute duration of the test, would also be documented (percentage of release group upstream and downstream of the array).
- For fish recaptured downstream, information would be compiled on the initial number of fish from each test group exhibiting a loss of equilibrium, number dead, and post-recapture survival 24, 48, 72, and 96 hours after testing.

Test Results

Data from each of the individual test groups would subsequently be compiled and analyzed statistically to determine whether significant differences exist between treatments (Barrier On) and controls (Barrier Off).

Results of the experiment would be documented in a technical report that would be provided to CDF&G, USFWS, and NMFS for review. The report would typically document measurements of the strength of the electrical field in addition to the biological parameters previously outlined.

The objective of the technical report would be to scientifically evaluate and determine whether exposure of these species to the electrical field being proposed for use in Chinese mitten crab control, would result in adverse affects on non-target species. To the extent that results of the measurements show no statistically significant difference between treatment and control groups, the agencies will find, based upon the best available scientific information, that application of the electrical barrier would result in no incremental incidental adverse impacts to listed species. This milestone marks the end of phase one.

Phase Two Testing

The electrical field measurements from "Phase One Testing" will become the baseline for continued improvement of the barrier i.e. less voltage for the fish and higher perceived voltage for crabs. Past experiments have revealed that the shape of the DC pulses have different effects on fish. Square and aperiodic pulses have less galvanotaxis effect on fish than sinusoidal or log decay. If it is proven that the first two pulse shapes have the desired effect on crab, then there will be an additional mitigation of the any effect on fish. During the experiments at the Bureau of Reclamation's Denver facility, we proved that the shape and orientation of the positive and negative electrodes had an enormous effect on the energy pattern generated by the barrier! This finding leads to the conclusion that the electrode arrangement may be analogous to a radio frequency antenna array.

Phase Two Testing Continued

This means that further experimentation can lead to focusing more energy parallel to the bottom of the waterway and less to the fish traveling higher in the channel. Although, the dielectric constant for air is one (1) and the constant for water will vary as a function of conductivity, experimentation should lead to formulae that will make empirical designs valid.

Test Site Location

This testing phase will take place in our electronics manufacturing facility located Las Vegas, NV.

- The changes to the electronics and barriers are less costly and are easily made in the actual manufacturing facility.
- The in-house test facility has a numerically controlled X-Y transport that will automate the recording of voltage fields.
- When the barriers are tested in-house for effectiveness with the Green Crab we will have no problem converting to seawater.

Note: MSI and the University of California's Sea Grant Operation will provide the Green Crabs used for testing. Green Crab testing will require the output of AEB's power supplies to be increased due to the higher conductivity of salt water.

Ecological/Biological Benefits

The project can benefit the entire Bay Delta area by:

1. Aiding the removal of Chinese Mitten Crabs and Green Crabs from the Ecosystem.
2. Making population surveys in remote locations without disturbing fish.
3. Providing an easily installed barrier when problems with crabs occur.

The reduction of crab populations will have a positive effect on all fish, some indigenous crabs, and levies. Large scale collection of live Mitten Crabs would make a fishery of spawning adults and juveniles possible or they can be used for animal feed, compost, or fertilizer.

The final barrier design will not exceed 10 inches in height or 12 in width. In some locations it may be desirable to turn off the unit if no migration is occurring. In effect, it provides a disappearing barrier.

Based on our experience with fish screens, the barriers should last 4 to 5 years. The materials used to construct the barriers are chosen resist corrosion and galvanic action.

There appears to be no conflict with any CALED plans or objectives, provided that it is proven that the system has no adverse effect on the fish involved. The barriers do not impede water flow, water transfers, or boat traffic.

Technical Feasibility and Timing

The feasibility of the system was proven at the Bureau of Reclamation Denver facility in January of 1999. The fact that the Splittale and Trout that were used in the tests showed no increased mortality after 4 weeks leads us to the conclusion that more finely tuned tests will have a positive outcome.

The Phase One testing will be completed within 30 days of funding. This is possible, as the Bureau of Reclamation will give us priority in scheduling the Tracy Flume for the 7 days of testing. The electronics and barriers will be fabricated in June at AEB's risk. Any agency that would like to view the testing is welcome and CDF&G, USFWS and NMFS will be informed one week in advance of the testing.

The Phase Two will consist of a continuing improvement of:

- Shorter duty cycle or pulse width.
- Optimization of pulse shape.
- Directing more energy parallel to the water way bottom and less to the surface where the fish tend to travel.

As each of the above improvements is fish friendly, only the crabs are required for testing.

This program will produce an approved barrier system in time for the fall adult Mitten Crab migration and all subsequent iterations of the barriers will be as effective on crabs but more fish friendly.

Monitoring and Data Collection Methodology

An ideal barrier would be 1" tall, 1" wide and direct 100% of the energy parallel to the bottom of the channel. As mentioned, the maximum height of the barrier will be 10 inches. Based on the Egeria and trash tests, the final height of the will be less than 10 inches as the lower profile will collect less weeds and trash. The desire to focus the energy along the bottom will also tend to push the profile lower.

As mentioned in the Project Description, "Square and aperiodic pulses have less galvanotaxis effect on fish than sinusoidal or log decay". The first tests and reports will show the best pulse shapes to deter the crabs that may be one or the other or somewhere in between.

The energy broadcast by the barrier is expressed as the voltage gradient as you increase the probe distance from the barrier. The diagram in the Executive Summary shows just such a pattern. Some artistic license was taken with that illustration. The reality is that the voltage decays increases the further you get from the electrodes. This decrease is on a semi-logarithmic curve and not is linear as shown. Phase

Local Involvement

As there are no plans to install a barrier at any location, no action is required at this time. The Bureau of Reclamation may install a barrier in front of the Tracy facility after Phase 1 testing is complete. If they make this installation, the Bureau will provide notices and obtain permits.

Cost

Total Budget for Phase 1 and Phase 2 testing and Program Management

Task	Direct Labor Hours	Direct Salery & Benefits	Service Contracts	Material & Acquisition Cost	Misc & Other Direct costs	Overhead & Indirect Costs	Total Cost
Phase 1	756	$ 17,890.00	$ 2,500.00	$ 18,500.00	$ 2,150.00	$ 14,316.00	$ 55,356.00
Phase 2	2268	$ 53,958.00	$ 500.00	$ 1,000.00	$ 1,500.00	$ 11,870.00	$ 68,828.00
Pgm Mgt	1008	$ 27,405.00	$ -	$ -	$ 750.00	$ 2,150.00	$ 30,305.00
Total		$ 99,253.00	$ 3,000.00	$ 19,500.00	$ 4,400.00	$ 28,336.00	$ 154,489.00

The Overhead costs for the Phase 1 program are above the 25% limit due to a higher than normal travel budget. This is required to support the testing at the Bureau of Reclamation in Denver. The charges also cover higher than normal in and out freight costs. All travel and lodging cost are per Federal Guidelines.

Funding is needed at the beginning of each quarter indicated.

Total Budget for Phase 1 and Phase 2 testing and Program Management

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Total		$ 99,253.00	$ 3,000.00	$ 19,500.00	$ 4,400.00	$ 28,336.00	$ 154,489.00

Cost-sharing

The Bureau of Reclamation is covering the cost of the Tracy Flume for seven (7) days at a price of $3500.00 per day or $24,500.00. This includes the cost of fish, crabs, and personnel.

Applicant Qualifications

Robert Peterson President of Aqualife Electrical Barriers Inc.

Robert holds a license from the state of California for water treatment, and has first hand experience working around water facilities from over 10 years employment with Metropolitan Water District.

Don Peterson Vice President, Aqualife Electrical Barriers Inc.

Don was with the Central Arizona Project for over 15 years as construction and program manager. He also served as chief engineer for new installations.

Donn Moore Vice President, Sales Manager, Aqualife Electrical Barriers Inc.

Named as co-inventor on Six patents and two patents in his name only. Designed and built military electronic systems for over forty years. Current owner and operator of Advanced Performance Technology located in Las Vegas Nevada.

Eric Schindler President of Schindler's llc

Is named as co-inventor on two pending patents relating to Electronic Fish Screen technology. Attended 2 years at UCLA towards a degree in Electrical Engineering.

Mark Schindler Vice President of Schindler's llc

Is named as co-inventor on two pending patents and several more in his name only. Is literally a rocket scientist having designed a piece of the space shuttle. Has worked in both military and commercial systems for over thirty years.

Complete biographies on request.

STATE OF CALIFORNIA

NONDISCRIMINATION COMPLIANCE STATEMENT

STD. 19 (REV. 3-95) FMC

Aqualife Electrical Barriers, Inc.

COMPANY NAME

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME

Donn Moore

DATE EXECUTED

15 April 1999

EXECUTED IN THE COUNTY OF

Clark

PROSPECTIVE CONTRACTOR'S SIGNATURE

PROSPECTIVE CONTRACTOR'S TITLE

President

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME

Advanved Performance Technology, Inc.

I-019781

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

Agreement No. _____

Exhibit _____

STANDARD CLAUSES --
SMALL BUSINESS PREFERENCE AND CONTRACTOR IDENTIFICATION NUMBER

NOTICE TO ALL BIDDERS:

Section 14835, et. seq. of the California Government Code requires that a five percent preference be given to bidders who qualify as a small business. The rules and regulations of this law, including the definition of a small business for the delivery of service, are contained in Title 2, California Code of Regulations, Section 1896, et. seq. A copy of the regulations is available upon request. Questions regarding the preference approval process should be directed to the Office of Small and Minority Business at (916) 322-5060. To claim the small business preference, you must submit a copy of your certification approval letter with your bid.

Are you claiming preference as a small business?

__XX__ Yes* _____ No

*Attach a copy of your certification approval letter.

Applied For, Not Available at this time