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

August 26, 2009

RE: **ILP PROJECTS**
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866, P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842, P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918, P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925, P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941, P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

Dear Secretary Bose,

Free Flow Power Corporation, on its own behalf and as the managing member of its individual subsidiary limited liability corporations, is pleased to submit our Proposed Study Plan (PSP) for the above-referenced hydrokinetic projects on the Mississippi River.

If you have any questions regarding this filing, please do not hesitate to contact Daniel Irvin at 978-712-2155 or me at 978-226-1531.

Sincerely,

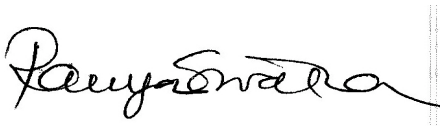
Ramya Swaminathan

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing Pre-Application Document and Notice of Intent upon each person designated on the official service list in the proceeding in accordance of the requirements of Rule 2010 of the Commission's Rules of Practice and Procedure.

In addition, I have served copies of the foregoing Pre-Application Document and Notice of Intent upon each person identified in the Notice of Intent Stakeholder Distribution List.

Dated: August 26, 2009



Ramya Swaminathan
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PROPOSED STUDY PLAN

August 28, 2009

Free Flow Power Corporation
33 Commercial Street
Gloucester, MA 01930

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

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SECTION 1

INTRODUCTION

SECTION 1 INTRODUCTION

Free Flow Power Corporation (FFP or the Applicant), on behalf of itself and fifty of its subsidiary limited liability companies (the LLCs), is filing with the Federal Energy Regulatory Commission (the FERC) this Proposed Study Plan (PSP) for:

- Seven Projects that are being processed under the FERC's Integrated Licensing Process (ILP):

FERC Project #	Project Name	Applicant
P-12829	Greenville Bend Project	Free Flow Power Corporation
P-12861	Scotlandville Bend Project	FFP Project 28, LLC
P-12921	Kempe Bend Project	FFP Project 32, LLC
P-12930	Ashley Point Project	FFP Project 41, LLC
P-12938	Hope Field Point Project	FFP Project 42, LLC
P-12915	Flora Creek Light Project	FFP Project 54, LLC
P-12912	McKinley Crossing Project	FFP Project 57, LLC

- Forty-Eight Projects that are being processed under the FERC's Traditional Licensing Process (TLP), pursuant to waivers granted by the FERC for these Projects

FERC Project #	Project Name	Applicant
P-12856	Ironton Light Project	FFP Project 3, LLC
P-12849	Live Oak Project	FFP Project 4, LLC
P-12862	Twelve Mile Point Project	FFP Project 5, LLC
P-12848	Algiers Light Project	FFP Project 6, LLC
P-12851	Gouldsboro Bend Project	FFP Project 7, LLC
P-12833	Carrollton Bend Project	Free Flow Power Corp
P-12866	Avondale Bend Project	FFP Project 10, LLC
P-12855	Kenner Bend Project	FFP Project 11, LLC
P-12853	St Rose Bend Project	FFP Project 12, LLC
P-12854	Fashion Light Project	FFP Project 13, LLC
P-12845	Thirty Five Mile Point Project	FFP Project 14, LLC
P-12864	Woodland Light Project	FFP Project 15, LLC
P-12858	Forty Eight Mile Point Project	FFP Project 16, LLC
P-12865	Remy Bend Project	FFP Project 17, LLC
P-12857	College Point Project	FFP Project 18, LLC
P-12842	Brilliant Point Project	FPF Project 19, LLC
P-12869	General Hampton Project	FFP Project 20, LLC
P-12863	Eighty One Mile Point Project	FFP Project 21, LLC
P-12860	Claiborne Island Project	FFP Project 22, LLC
P-12843	White Alder Project	FFP Project 23, LLC
P-12844	Point Pleasant Project	FFP Project 24, LLC
P-12828	Reliance Light Project	Free Flow Power Corp
P-12822	Manchac Point Project	Free Flow Power Corp
P-12817	Duncan Point Project	Free Flow Power Corp
P-12918	Sara Bend Project	FFP Project 29, LLC
P-12927	Morgan Bend Crossing Project	FFP Project 30, LLC
P-12924	Newton Bend Project	FFP Project 33, LLC
P-12922	Milliken Bend Project	FFP Project 35, LLC
P-12919	Cat Island Project	FFP Project 36, LLC
P-12928	Anconia Point Project	FFP Project 37, LLC

FERC Project #	Project Name	Applicant
P-12926	Walker Bend Project	FFP Project 38, LLC
P-12925	Malone Field Light Project	FFP Project 39, LLC
P-12929	Helena Reach Project	FFP Project 40, LLC
P-12931	Plum Point Project	FFP Project 43, LLC
P-12942	Bar Field Bend Project	FFP Project 44, LLC
P-12937	Huffman Light Project	FFP Project 45, LLC
P-12936	Little Prairie Bend Project	FFP Project 46, LLC
P-12932	Williams Point Project	FFP Project 47, LLC
P-12934	New Madrid Bend Project	FFP Project 48, LLC
P-12933	Hickman Bend Project	FFP Project 49, LLC
P-12941	Wickliffe Project	FFP Project 50, LLC
P-12940	Greenfield Bend Project	FFP Project 51, LLC
P-12939	Gale Light Project	FFP Project 52, LLC
P-12914	Cape Bend Project	FFP Project 53, LLC
P-12917	Ste. Genevieve Bend Project	FFP Project 55, LLC
P-12935	Arsenault Island Project	FFP Project 56, LLC
P-12913	Wilson Island Project	FFP Project 58, LLC
P-12916	Mobile Island Project	FFP Project 59, LLC

The terms "Free Flow Power Corporation," "FFP," or "Applicant" in this document shall refer collectively to Free Flow Power Corporation and the LLCs. The term "FFP Projects" in this document shall refer collectively to the above-referenced projects.

The PSP Document has been developed in accordance with 18 CFR § 5.11. In addition to FFP's proposed study plans, this document also includes FFP's response to stakeholder study requests and a schedule for conducting study plan meetings.

There are three types of studies proposed in this PSP Document:

- Studies that are not site-specific, but are designed to assess particular impacts of FFP's technology or deployment approach and therefore, are applicable to all FFP Projects
- Studies that are site-specific, and whose conclusions may not be applicable to other FFP Projects, but whose methodologies are transferable
- Stduies that are site-specific, but whose conclusions are transferable across all FFP Projects

The filing of the PSP Document is a milestone for developing license applications for each of the applicable ILP Projects under the FERC's ILP. FFP also intends that the design and results for the studies in this PSP will be applicable to the TLP Projects.

In accordance with the ILP regulations, the PSP Document is being filed with the FERC and simultaneously distributed to each person identified on the attached Service List.

Master Study Plan Schedule
2010

STUDY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Turbine Siting Study	Study Begins			QPR			QPR			ISR		
Navigation Study	Study Begins			QPR			QPR			ISR		
Hydraulic Study	Study Begins			QPR			QPR			ISR		
Fish Entrainment Study	Study Begins			QPR			QPR			ISR		
EMF Study	Study Begins			QPR			QPR			ISR		
Acoustic Energy Study	Study Begins			QPR			QPR			ISR		
Vegetation, Wildlife, and Noxious Weeds inventory	Study Begins			QPR			QPR			ISR		
Commercial Fishing and Recreation Study	Study Begins			QPR			QPR			ISR		
Archeological and Historic Resource Surveys	Study Begins			QPR			QPR			ISR		
Damaged or Abandoned Turbine Recovery Study	Study Begins			QPR			QPR			ISR		
RTE Species Study	Study Begins			QPR			QPR			ISR		

QPR = Quarterly Progress Report
ISR = Initial Study Report

SECTION 2

RESPONSES TO
ADDITIONAL INFORMATION REQUESTS

QUESTION 1:

Design Criteria, Reliability, Operations and Maintenance, Decommissioning and Energy Production

As described within the FERC's Additional Information Request (AIR), FFP will file a complete response to this AIR in coordination with our study report responding to the FERC's Study Request #1, Turbine Siting Study.

We are providing the following information at this point in time in partial fulfillment of this AIR.

1.A Structural Design Criteria

Loads

The predominant loads on FFP's turbine arrays are generated from streamwise (in the direction of flow) velocity according to the equation:

F= Cd * A * RHO * V^2,

Where:
Cd is the effective drag coefficient,
A is the frontal area,
RHO is the density of water,
and V is velocity.

The driving factor is velocity, and seasonal changes in it. The other variables are essentially constant.

Each turbine is designed to operate in river flows up to 5 meters/second, with a nominal operating condition of 2.25 m/s. Forces on the turbine are calculated from Computational Fluid Dynamics (CFD) analysis using a maximum river speed of 5 m/s, and then adjusted to the operating water speed. With the 5 m/s forces, the turbines have been analyzed using Finite Element Analysis (FEA), and show a design factor of safety above 9 on the primary structural parts (turbine, strut, housing).

With respect to CFD analysis, the constituent equations used to solve the Navier-Stokes equations are the continuity equation, momentum equation, energy equation, viscosity and the law of the wall. With respect to FEA, structural equations are applied to the material and the forces applied to determine the stress and deflection states of the material. Forces considered in the analysis are pressure, weight, rotational, thermal, displacements, and interaction types (bolts, friction, coupling with other parts or devices,

etc.). The solution is then calculated to achieve the minimal energy solution and deflections from the material characteristics of density, stiffness(es) (Youngs Modulus and thickness), and geometric response (Poissons Ratio). Stresses are then calculated using Youngs modulus:

$$\sigma = E / \varepsilon$$

Where:
σ is stress,
E is Youngs modulus, and
ε is the strain from the FEA solution.

To determine the forces on the SmarTurbine™ Generator, FFP modeled turbine assembly at water speeds using CFD models, integrated the pressure and friction forces in order to run FEA analysis. The resultant forces for the turbines at desired water speeds are used to calculate forces, deflections and stresses for the mounting systems. Loads are the sum of each turbine, the drag forces on the turbine mount structures, and the drag forces on the pylons and cables. Each turbine mount will be designed for a minimum of 10 years of life with the structural (including vibration) factors and environmental effects accounted for, and to a minimum factor of safety of 3 or to code requirements

As with the turbine mounts, the pylons will meet or exceed code requirements for the array of turbines, or with a minimum 20 year life at a factor of safety of 3. All appropriate civil engineering and material codes will be followed, and the stresses will be based on the sum of all the forces present and the bending stresses arising from the accumulated forces.

Transient Forces

In addition to long term, or seasonal, variations, flow direction can also vary rapidly due to more transient forces. Rapid changes include turbulence, which imposes normal (perpendicular) or circumferential on top of the streamwise direction. The component magnitudes are small relative to the streamwise values, but are rapid enough to create time-varying side loads. FFP will quantify these magnitudes and design for these loads, by obtaining data for flow direction magnitudes and frequency, and then run CFD analysis followed by FEA analysis to quantify the loads, stresses, and deflections from these flow components.

Flow directions may also change with time, and FFP has designed for small variations (up to 5 degrees). Larger variations, to the extent they occur with seasonal variations, or due to large changes in flow rate, are presently being evaluated with regards to mounting design and orientations, with consideration being given to mounts that adapt to these flow direction changes.

Another transient force is rotational imbalance in the machine. Mass imbalance forces are minor. Imbalances in loads, for example with a bag caught on a blade, are a source of

vibration, but we do not foresee any stress concerns with these loads. The individual loads are small compared to the design loads, and, most importantly, the natural frequencies of the system are not matched to the imbalance forces; that is, there will not be a resonant response.

Resonant frequencies are also calculated using FEA methods. In simplistic terms, the methodology employs calculating the stiffness and mass of each part, then determining the harmonics of the natural frequencies. In its most basic formulation, a spring – mass system will respond according to:

$$f_n = 1/ (2*\pi)*(k/m)^{1/2}$$

Where:
f_n is the frequency
k is the stiffness
m is the mass

As well as this fundamental frequency, harmonics and higher order modes may also resonate. The FEA analysis determines these natural frequencies (modal frequencies and shapes), and will inform design changes to prevent this from happening in our design operating envelope. This is standard engineering methodology, and is used on many mechanical systems, such as jet engines and aircraft.

The vibrations due to eddy generation on the turbines and the pylons are at high enough frequencies and low enough magnitude that we do not predict any significant vibrational stresses from these factors.

Debris, Sediment, and Ice Loads

Free Flow Power's turbines and pylon systems are designed to work without failure in "normal" Mississippi River conditions, based on statistical and pragmatic analysis. The turbines' location below the surface and above the river bed suggests that buoyant debris, including ice, will pass overhead and that tumbling negatively buoyant items of a designated size will go by below the systems. The pylons could encounter bed level debris, but this is a well categorized design factor. In other words, the turbines will be designed to be placed out of harms way by the majority of known debris.

Neutrally buoyant debris, such as waterlogged tree trunks, although less likely to occur, may cause damage to the turbines. Our economic models reflect the need to replaced damaged units when this occurs.

Impact loads are best expressed as the ability to absorb a certain amount of energy from the article that hits the turbine blade or assembly. The design is intended to absorb the energy of small to medium sized objects moving at normal river speeds without failure.

Energy is expressed as:

$$E = \frac{1}{2} * m * v^2$$

Where:
E = energy
m = mass
v = velocity

We anticipate that we will perform tests to determine the maximum object size and speed that will not damage our devices. For the turbine rotor, the energy absorbed can be calculated as:

$$E = \frac{1}{2} * k * x^2$$

Where:
E = energy
k = turbine stiffness (from FEA)
x = displacement (from FEA)

So, equating the energy of these two, assuming 3.0 m/s object velocity, and calculating the stiffness and displacement allowed prior to cracking, we can calculate the mass of a foreign object that will not damage our machine as:

$$m = k * x^2 / v^2$$

Sediment is considered a normal environmental object to our turbines, and flow of sand will not create unforeseen structural forces. Although not a load, the effect of sediment on wear (abrasion) is factored into the equipment in terms of material election and coatings used.

The SmarTurbine™ Generators will be operating with active, real time monitoring. Should operation exceed the allowable bounds of load, vibration, speed, or other factors, we can automatically disable the system and power. Should a fault be identified, or should a loss of regulation occur, the system will have protections that stop rotation (i.e. brake the turbine), or isolates electrical power. As well as individual turbines, the array, or entire system can similarly be protected. This includes a loss of grid power.

1.B Electrical Design Criteria

As described within the FERC's Additional Information Request (AIR), FFP will file a complete response to this AIR in coordination with our study report responding to the FERC's Study Request #1, Turbine Siting Study.

1.C Equipment Reliability

As described within the FERC's Additional Information Request (AIR), FFP will file a complete response to this AIR in coordination with our study report responding to the FERC's Study Request #1, Turbine Siting Study.

1.D Structural Reliability

As described within the FERC's Additional Information Request (AIR), FFP will file a complete response to this AIR in coordination with our study report responding to the FERC's Study Request #1, Turbine Siting Study.

1.E Operation, Maintenance, and Decommissioning

As described within the FERC's Additional Information Request (AIR), FFP will file a complete response to this AIR in coordination with our study report responding to the FERC's Study Request #1, Turbine Siting Study.

QUESTION 2:

Shore-Based Infrastructure

As described within FERC's Additional Information Request (AIR), FFP will file a complete response to this AIR in coordination with our study report responding to the FERC's Study Request #7, Vegetation, Wildlife Habitat and Noxious Weeds Inventory.

QUESTION 3:

Fish and Invertebrate Surveys

Pursuant to the requirement in the FERC's AIR #3 for consultation with the US Fish & Wildlife Service, the National Marine Fisheries Service, the Arkansas Game and Fish Commission, the Illinois Department of Natural Resources, the Louisiana Department of Wildlife and Fisheries, the Mississippi Game and Fish Commission, the Missouri Department of Conservation, and the Tennessee Wildlife Resources Agency, FFP contacted each of the above entities upon receipt of the AIR. The AIR had also indicated a requirement to consult with the Kentucky Department of Fish and Wildlife Resources. As there no Lead Sites in the State of Kentucky, however, staff of the FERC clarified that consultation with the Kentucky Department of Fish and Wildlife Resources was not necessary for purposes of responding to this AIR.

Since the timeline imbedded within the AIR called for a draft response to be prepared and then circulated to the consulted agencies with a comment period of the 30 days provided, FFP requested an extension for response to this AIR from the FERC. FFP is currently compiling the responses received from the resource agencies and will circulate a draft response for review and comment prior to filing the final response to this AIR.

SECTION 3

SUMMARIES OF APPLICANT PROPOSED STUDY PLANS

SECTION 3 SUMMARIES OF APPLICANT PROPOSED STUDY PLANS

This PSP Document has been developed in accordance with 18 CFR § 5.11. In addition to FFP's proposed study plans, this document also includes FFP's response to stakeholder study requests and a schedule for conducting study plan meetings.

FFP is proposing eleven Study Plans within this PSP.

- Turbine Siting Study
- Navigation Study
- Hydraulic Study
- Fish Entrainment Study
- Electromagnetic Field Study
- Acoustic Energy Study
- Vegetation, Wildlife and Noxious Weeds Inventory
- Recreation Study
- Archeological and Historical Resource Surveys
- Damaged or Abandoned Turbine Recovery Study
- Rare, Threatened and Endangered Species Study

A brief summary of each is provided below.

3.1 Turbine Siting Study

FFP is proposing a study to determine the number, location and configuration of turbines that can be deployed at each site while minimizing potential for adverse impact on other important river uses and resources. In order to do this, FFP will determine a maximum elevation for turbine infrastructure selected to avoid adverse effects on navigation and evaluate other constraints, such as previously permitting competing uses such as commercial dredging and fleeting, that may limit the number or location of turbines that can be deployed at each site.

The results of this study will be used to inform actual siting of turbines, pilings and associated deployment sytems within each Project Site.

3.2 Navigation Study

FFP is proposing a study to gather information necessary to develop a plan to deploy hydrokinetic turbines in a manner that will minimize adverse affects on river navigation. In order to do this, FFP will assess existing river navigation patterns and determine construction and maintenance practices that would minimize impacts to river navigation and risks to public safety

The results of this study will be used by FFP to determine protocols for installation and operation and maintenance for in a manner that minimizes adverse effects on navigation.

3.3 Hydraulic Study

FFP is proposing a hydraulic study to assess the potential impact of the deployment of hydrokinetic turbines on flow velocities and sedimentation. Changes in flow velocities and sedimentation could have implications for navigation and dredging, habitat for riverine biota, the integrity of US Army Corps of Engineers structures, and natural riverbank stability, either positive or negative.

In order to do this, FFP will

- determine metric for measuring impact on flows and on sedimentation from deployed turbines
- determine thresholds for impact: effects smaller than determined thresholds will be considered de minimis
- determine the force or "drag" from a single turbine and small groups of turbines and the effect of the drag on flow energy and behavior.
- assess the impact of turbine deployment on flow conditions and sedimentation, on a site specific basis
- evaluate the implications of any determined changes on navigation, including potential for vertical updrafts, CoE structures, natural river bank stability, and aquatic habitat based on threshold criteria established

The results of this study will help identify any such impacts and implications and will inform the effective siting of turbine arrays, as well as assist in the formulation of protection, mitigation and enhancement (PME) measures, if necessary.

3.4 Fish Entrainment Study

FFP is proposing a study to investigate the nature and rate of injury to relevant fish species, or potentially surrogate species for Mississippi River fishes. This will enable evaluation of the potential for fishes to be injured due to passage through or in direct contact with the turbines and the potential cumulative effects of any turbine mortality and injuries on fisheries resources in all relevant Project Areas. In order to do this, FFP will determine the size range of fish species that may grow to large sizes in the Mississippi River, and assess probability of these species to strike-related injuries, based on existing data and either a laboratory-based or *in situ* testing program with a specially designed injection system, whereby fishes will be injected into the turbine.

The results of this study will help characterize project effects on adult, juvenile, and larval fishes in Project Sites and assist in the development of mitigation strategies.

3.5 Electromagnetic Field (EMF) Study

FFP is proposing a study to assess the magnitude and impact of electromagnetic field generation from the SmarTurbine™ and associated cabling systems, and the extent to which that field propagation is likely to affect aquatic biota and/or navigation.

To perform this study, FFP will identify the contributions to overall electromagnetic field generation from each of the components of the turbine and cabling system, determine the baseline fields in the absence of our systems and the field effects introduced by our systems, determine if there are any increased levels of significance and then assess these levels with known effects on various species and navigation systems.

The results of this study will provide metrics and thresholds to determine nature and magnitude of impact and help in the development of mitigation plans, should any be necessary.

3.6 Acoustic Energy Study

FFP is proposing a study to assess the magnitude and impact of acoustic energy generation and propagation from the SmarTurbine™ Generator system. To perform this study, FFP will measure near field energy spectrum and amplitude and far field energy spectrum and amplitude, as appropriate, and conduct a literature survey to determine existing data on sound propagation in rivers and the effects of acoustic energy on fish and other aquatic species.

The results of this study will provide metrics and thresholds to determine nature and magnitude of impact and help in the development of mitigation plans, should any be necessary.

3.7 Vegetation, Wildlife, and Noxious Weeds Inventory

FFP is proposing a study to identify and gather necessary information needed to understand wetland, riparian, and other wildlife habitats present in areas subject to disturbance by project-related activities.

The results will include maps showing the vegetation cover types within all areas with proposed access roads, onshore cables, and substations, or primary transmission lines of the proposed leading projects.

FFP will consider this information to determine whether the proposed construction of transmission lines, substations, and any necessary access roads would affect shore line vegetation and habitat; and whether there is any unique or important shoreline habitat throughout the project area that should be protected.

3.8 Commercial Fishing and Recreation Study

FFP is proposing a study to evaluate the impact of its proposed hydrokinetic Projects on recreational resources, including use of, access to, and safety concerns about recreational facilities and commercial fishing grounds.

The results of this study will include an assessment of how any project construction, operation, and maintenance measures would affect commercial fishing and recreational opportunities and access. These results will also help in the development of potential protection, mitigation, and enhancement (PME) measures.

3.9 Archeological and Historical Resource Surveys

FFP is proposing a study to identify above-water historic properties within the Area of Potential Effect (APE) for each of its Projects in order to determine the Projects' potential effects on historic properties.

The results of this study will be used to develop protection, mitigation and enhancement (PME) measures for historic properties in the Projects' APE. The PME measures will be incorporated into the Historic Properties Management Plan (HPMP), which will be filed with FERC if any historic property is determined to be adversely affected by the project.

3.10 Damaged Turbine Recovery Study

FFP is proposing a study to evaluate the strength and breakaway thresholds of the turbine arrays in order to determine the probability of a turbine breaking free from an array and the likelihood that such a breakaway turbine would have an adverse impact on the environment, navigation or other areas of concern to stakeholders, and, if necessary, determine how damaged turbine features would be recovered from the river bottom.

The results of this study will help FFP determine how to mitigate any potential adverse impact to navigation or riverine biota.

3.11 Rare, Threatened and Endangered Species Study

FFP is proposing a study to identify rare, threatened, and endangered species within each of its Lead Projects based on existing data collected through consultation and research. This study will evaluate the potential effects of proposed projects on RTE species and on their habitats.

A complete study report will detail the methods and results, as well as, include maps, GIS data, assessments of project-related effects on RTE species and their habitats. The results will also include discussions of proposed PME measures.

SECTION 4

RESPONSES TO STAKEHOLDER STUDY REQUESTS

SECTION 4 RESPONSES TO STAKEHOLDER STUDY REQUESTS

FFP filed its Notice of Intent (NOI) and Pre-Application Document (PAD) in connection with its 55 Mississippi River Project Sites, including the seven Lead Sites, on January 15, 2009. FERC issued Scoping Document 1 on March 16, 2009. FERC staff conducted 10 public scoping meetings, one daytime and one evening, on these Projects according to the following schedule:

- Vicksburg on April 14, 2009
- New Orleans on April 28, 2009
- Baton Rouge on April 29 and April 30, 2009
- Memphis on May 4 and May 5, 2009
- St. Louis on May 7, 2009

Within that time frame, FFP conducted 6 site visits at the following Project Sites on the following dates:

- Project 8, Greenville Bend, on April 27, 2009
- Project 28, Scotlandville Bend, on April 29, 2009
- Project 41, Ashley Point, on May 4, 2009
- Project 42, Hope Field Point, on May 4, 2009
- Project 54, Flora Creek Light, on May 6, 2009
- Project 57, McKinley Crossing, on May 6, 2009

In accordance with ILP regulations, comments on the PAD, Scoping Document 1 and Study Requests were due to FERC on July 14, 2009. FFP has reviewed all stakeholder comments and Study Requests included in the FERC record.

FFP's determination on the appropriateness of a Study Request is based on the FERC's seven criteria for Study Requests (18 CFR § 5.9(b)), which states that any information or study request must:

A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
C. If the requester is not an a resource agency, explain any relevant public interest considerations in regard to the proposed study;
D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection

and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;

G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

Summaries of Stakeholder Study Requests:

A total of 13 comment letters were filed with FERC by July 14, 2009. These letters included a variety of comments on the PAD, recommendations for matters to include in the EIS, and several study requests. We are summarizing the Study Requests below.

4.1 Federal Energy Regulatory Commission (FERC)

On July 14, 2009, the FERC filed a letter that outlined three Additional Information Requests (AIRs) and ten Study Requests. The AIRs are treated in Section 2 of this PSP. FFP has summarized its response to each of FERC's Study Requests below:

4.1(a) Turbine Siting Study

The FERC proposed a study that would ultimately determine the number, location and configuration of turbines at each site. FFP has determined this request to be appropriate for study and has included the majority of its elements as a proposed study plan, provided in Section 6 of this PSP.

4.1(b) Navigation Study

The FERC proposed a study that would provide a summary of available information on navigation patterns, including commercial and recreational traffic, propose strategies to minimize interference with navigation and estimates of costs of any restrictions. FFP has determined this request to be appropriate for study and has included it as a proposed study plan, provided in Section 6 of this PSP.

4.1(c) Geomorphology and Water Quality

The FERC proposed a study that would assess sediment transport and geomorphic characteristics of the Mississippi River, and evaluate site specific and cumulative effects of FFP's proposed hydrokinetic turbine deployment. The content of FFP's proposed Hydraulic Study is responsive to the information needs contained within this study request. The Hydraulic Study is included as a proposed study plan, provided in Section 6 of this PSP.

4.1(d) Flood Risk Study

The FERC proposed a study that would determine the potential effects of flow resistance on water levels over a range of flow conditions, including effects on water levels and

potential changes in water levels caused by changes in river bathymetry. The content of FFP's proposed Hydraulic Study is responsive to the information needs contained within this study request. The Hydraulic Study is included as a proposed study plan, provided in Section 6 of this PSP.

4.1(e) Fish Entrainment Study

The FERC proposed a study that would determine the size range of fish species in the Mississippi River, and, particularly for the large species, evaluate their susceptibility to strike injuries. The content of FFP's Entrainment Study, which proposes a modeling approach to measuring certain turbine parameters, a literature review and a laboratory or in-situ testing program, is consistent with the content of this study request and is included as a proposed study plan, provided in Section 6 of this PSP.

4.1(f) Fish Habitat

The FERC proposed a study that would, through literature review, evaluate the effects of structural elements in the flow path of the Mississippi River on fish distribution and abundance, and sensitivities and responses of fish species to electromagnetic fields (EMF) and acoustic energy. FFP's EMF Study, Acoustic Energy Study, and Hydraulic Study address the different elements of this study request and each of those is included as a proposed study plan, provided in Section 6 of this PSP.

4.1(g) Vegetation, Wildlife Habitat, and Noxious Weeds Inventory

The FERC proposed a study that would quantitatively describe and map vegetation cover types and associated wildlife, delineate and map all wetlands according to the CoE 1987 manual, and map all invasive species in the areas where ground disturbance is proposed. FFP has determined this request to be appropriate for study and has included it as a proposed study plan, provided in Section 6 of this PSP.

4.1(h) RTE Survey

The FERC proposed a study that would determine the abundance and distribution of RTE species in consultation with appropriate resource agencies.

FFP has proposed a RTE Study that proposes to document any known occurrences of and habitat availability for rare, threatened, and endangered (RTE) species from existing sources, including the resource agencies named in this study request and including the CoE and the USGS.

4.1(i) Recreation Study

The FERC proposed a study that would evaluate potential adverse impacts of FFP Projects on recreational resources, through the creation of a recreational facility inventory and a recreation use and needs assessment. FFP's Commercial Fishing and Recreation

Study, provided in Section 6 of this PSP, is responsive to the issues raised in this study request.

4.1(j) Archeological and Historic Resource Survey

The FERC proposed a study that would evaluate potential adverse impacts of FFP Projects on archeological and historic resources, through the identification of an Area of Possible Effect (APE), assessment of eligibility for inclusion in the National Register of Historic Places, and if adverse impact is expected, prepare draft Historic Property Management Plan(s). FFP has determined this study to be appropriate for study and has adopted it with modifications as a proposed study plan, provided in Section 6 of this PSP.

4.2 US Army Corps of Engineers (CoE)

On July 14, 2009, the CoE filed a letter that outlined ten Study Requests. FFP has summarized its response to each of CoE's Study Requests below:

4.2(a) Bank Stability and Impact to Corps Revetment and River Training Structures

The CoE proposed a study that would assess the potential impact of FFP turbine deployments on natural riverbank stability and CoE structures. This study is envisioned to help FFP determine the minimum distance that turbines would be installed so that induced flow or scouring effects do not adversely affect natural river bank stability or undermine CoE structures.

In this study request, the CoE proposes use of a physical to-scale model. Physical to-scale models can be useful for modeling certain kinds of flow and sedimentation behavior, but are most useful in the consideration of relatively simple and localized problems, e.g. evaluation of sedimentation changes due to a few pilings in a localized area. Use of a physical to-scale model is not useful in the design of FFP's Study Plan because the scale used in typical physical to-scale models would not allow the study of the impact of turbines, as they would be too small. Expanding the scale of a to-scale model enough to allow robust studies of the impacts of the turbine would be cost prohibitive.

FFP's Hydraulic Study will evaluate the potential for adverse impact to CoE structures and natural riverbank stability and therefore, is responsive to the information needs raised by this study request. FFP is proposing the use of numerical models; both depth-integrated 2D and 3D Computational Fluid Dynamics (CFD) models will be used in FFP's proposed study. FFP's Hydraulic Study is included as a proposed study plan and is included in Section 6 of this PSP.

4.2(b) Damaged Turbine Recovery Methods

The CoE proposed a study to calculate breakaway thresholds for turbine damage and determine how damaged turbine parts would be recovered. FFP has determined this study

to be appropriate for study and has included it, with modifications, as a proposed study plan, provided in Section 6 of this PSP.

4.2(c) Commercial Fleeting and Dredging Competing Use

The CoE proposed a study to calculate the potential impact of FFP Projects on existing barge fleeting operations and on existing commercial dredging operations. The Turbine Siting Study proposed by the FERC and adopted as to a majority of its elements by FFP is responsive to the content of this study request. That study is included as a proposed study plan and is included in Section 6 of this PSP.

In the case of both barge fleeting and commercial dredging operations, FFP is proposing to account for currently permitted activities and not for potential future expansion for the following reasons:

- It would be speculative
- If future expansion is contemplated after FFP Projects are licensed, plans for future expansion would have to account for FFP Projects as a competing use

4.2(d) Commercial and Recreational Navigation Concerns

The CoE proposed a study to assess potential navigation safety and impedance effects on commercial and recreational navigation by modeling river current alterations.

In this study request, the CoE proposes use of a physical to-scale model. Physical to-scale models can be useful for modeling certain kinds of flow and sedimentation behavior, but are most useful in the consideration of relatively simple and localized problems, e.g. evaluation of sedimentation changes due to a few pilings in a localized area. Use of a physical to-scale model is not useful in the design of FFP's Study Plan because the scale used in typical physical to-scale models would not allow the study of the impact of turbines, as they would be too small. Expanding the scale of a to-scale model enough to allow robust studies of the impacts of the turbine would be cost prohibitive.

FFP's Hydraulic Study will evaluate the potential effects of turbine deployment on navigation safety and impedance impacts due to flow alterations and therefore, is responsive to the information needs raised by this study request. FFP is proposing the use of numerical models; both depth-integrated 2D and 3D Computational Fluid Dynamics (CFD) models will be used in FFP's proposed study. FFP's Hydraulic Study is included as a proposed study plan and is included in Section 6 of this PSP.

4.2(e) Installation Methods, Timeframe and Impacts to Navigation

The CoE proposed a study to determine installation methods that minimize adverse impacts to navigation during installation and operation and maintenance cycles and develop a contingency plan for safe navigation procedures during the installation of FFP Projects.

The Navigation Study, proposed by the FERC and adopted by FFP, is responsive to the contents of this study request. That study is included as a proposed study plan and is included in Section 6 of this PSP.

4.2(f) Navigation Radio Interference from Electrical Generation

The CoE proposed a study to determine whether electrical generation by FFP's SmarTurbine™ Generator and transportation of electricity through the associated cabling could cause interference with navigation radio communications and other electronic devices.

The content of this study request is addressed by FFP's proposed EMF Study Plan. That study is included as a proposed study plan and is included in Section 6 of this PSP.

4.2(g) Sediment Transport Changes and Corps Channel Maintenance Dredging

The CoE proposed a study to determine FFP Projects' potential alteration of sediment transport within the Mississippi River and the CoE's channel maintenance dredging program.

In this study request, the CoE proposes use of a physical to-scale model. Physical to-scale models can be useful for modeling certain kinds of flow and sedimentation behavior, but are most useful in the consideration of relatively simple and localized problems, e.g. evaluation of sedimentation changes due to a few pilings in a localized area. Use of a physical to-scale model is not useful in the design of FFP's Study Plan because the scale used in typical physical to-scale models would not allow the study of the impact of turbines, as they would be too small. Expanding the scale of a to-scale model enough to allow robust studies of the impacts of the turbine would be cost prohibitive.

FFP's Hydraulic Study will evaluate the potential effects of turbine deployment on sediment transport due to flow alterations and therefore, encompasses the content of this study request. FFP is proposing the use of numerical models; both depth-integrated 2D and 3D Computational Fluid Dynamics (CFD) models will be used in FFP's proposed study. FFP's Hydraulic Study is included as a proposed study plan and is included in Section 6 of this PSP.

4.2(h) Mississippi River and Tributaries (MR&T) Project

The CoE proposed a study that would evaluate the potential impact of FFP Projects on the MR&T Project and the Project Design Flood (PDF) flowline.

In this study request, the CoE proposes use of a physical to-scale model. Physical to-scale models can be useful for modeling certain kinds of flow and sedimentation behavior, but are most useful in the consideration of relatively simple and localized problems, e.g. evaluation of sedimentation changes due to a few pilings in a localized area. Use of a

physical to-scale model is not useful in the design of FFP's Study Plan because the scale used in typical physical to-scale models would not allow the study of the impact of turbines, as they would be too small. Expanding the scale of a to-scale model enough to allow robust studies of the impacts of the turbine would be cost prohibitive.

FFP's Hydraulic Study will evaluate the potential effects of turbine deployment on the integrity of CoE structures and on any alteration in the level of flood risk, and therefore, encompasses the content of this study request. FFP is proposing the use of numerical models; both depth-integrated 2D and 3D Computational Fluid Dynamics (CFD) models will be used in FFP's proposed study. FFP's Hydraulic Study is included as a proposed study plan and is included in Section 6 of this PSP.

4.2(i) Jurisdictional Waters of the United States

The CoE proposed a study to evaluate the impact of FFP Projects on wetlands, based on wetland delineations performed according the 1987 Wetland Delineation Manual.

The content of this study request is contained within the content of the Vegetation, Wildlife Habitat and Noxious Weeds Inventory, proposed by the FERC and adopted by FFP. That study is included as a proposed study plan and is included in Section 6 of this PSP.

4.2(j) Aquatic Life Impacts

The CoE proposed a study to analyze the effect of FFP Project deployment on aquatic species, including effects from direct impact, avoidance measures, wounds or death. In addition, the CoE proposes using balloon tagging species.

The content of this study request is encompassed by several studies proposed by FFP:

- Fish Entrainment Study, which, by injecting relevant fish species directly through the turbine, enables the study of direct and delayed injury and mortality
- EMF Study, which evaluates the impact of EMF fields generated and propagated by the FFP SmarTurbine™ Generator and associated systems
- Acoustic Energy Study, which evaluates the impact of the acoustic energy generated and propagated by the FFP SmarTurbine™ Generator and associated systems
- Hydraulic Study, which includes the identification of aquatic species most at risk of risk of injury or harm as a result of flow changes, and uses particle tracking methods to define the conditions experienced in both near field and far fields, and exposure histories experienced by different fish species

FFP is not proposing the use of balloon tagging as a method of evaluating impacts to aquatic species. Rather, FFP favors an approach where fish are injected directly into the turbine in a methodical, observed fashion. This is a scientifically preferable methodology for a number of reasons:

- it enables the isolation of factors relevant to the impact of the turbine itself;
- enables the recording of and comparison to control data;
- and, field observation without direct injection would include interpretation of data that would fluctuate for reasons uncorrelated with turbine operation.

4.3 US Fish and Wildlife Service (FWS), Department of the Interior

On July 14, 2009, the Department of the Interior, filed a letter that outlined 3 broad study requests from the FWS, one of which had several sub-sections.

4.3(a) Hydraulic Effects

The FWS requests a hydraulic study whose objective is to provide information about changes in hydrodyanamics potentially caused by FFP Projects and the effect of these changes on aquatic biota.

FFP's Hydraulic Study addresses the issues raised by this study request.

Two notable differences in methodology are proposed by FFP in its Hydraulic Study.

- FFP is not proposing to study zooplankton or phytoplankton. A history of extensive and intensive studies on conventional power plants indicates that zooplankton and phytoplankton may experience mortality but the primary stressors are thermal elevations and biocide usage, with little effect due to mechanical stressors. Appropriate references are provided within the Hydraulic Study.
- FFP proposes to use a depth-integrated two-dimensional model to perform a number of functions within the study. Although some of those functions are not specifically of interest to the FWS, several are responsive to issues raised within this study request, including:
  - Create boundary conditions for the 3D river model. This will be the distribution of flow and sediment concentration at the upstream boundary of the 3D river model.
  - Horizontal depth-averaged currents, concentration, and bed changes will be calculated over a seasonal time period.
  - Assess impact of hydrokinetic deployment on sediment and currents, particularly those that are far away.

This methodology is consistent with generally accepted practice within the scientific community and references are provided within the Hydraulic Study, included in Section 6 of this PSP.

4.3(b) Riverine Fish Populations

FWS proposed a study to provide information about the composition and abundance of fish assemblages in the project areas through the use of fish collection (though deep-water electrofishing, gill netting, trammel netting, trotlining and larval drift netting) to supplement the information FWS also requests in other studies recommending hydroacoustic surveys and telemetry surveys.

FFP believes that this study request inadequately addresses FERC criterion 5, Nexus to the Project. The nature of baseline data required for an analysis of hydrokinetic generation is necessarily different from the nature of baseline data at conventional hydroelectric generation projects, as unlike in a conventional hydro project, the electrical system is not contained at a single location. Baseline data on species presence or absence from any particular site would fluctuate radically due to variables not linked, either directly or indirectly, to hydrokinetic turbines. Sampling in Project Sites is unlikely to provide useful information relevant to licensing decisions.

In addition, through conversations with scientists with expertise in Mississippi River species and habitat, FFP understands that there have been exhaustive data collection efforts on fish assemblages over large areas of the Mississippi River that have taken place over as many as ten years that FFP could not hope to replicate, without it being cost-prohibitive and taking many years. FFP intends to use these existing data rather than limited sampling within Project Sites.

For these reasons, FFP is not adopting this study request.

4.3(c) Riverine Fish and Aquatic Invertebrate Entrainment and Mortality

FWS proposed a study to determine the nature and extent of fish, invertebrate and zooplankton injury, direct and delayed mortality as a result of passage through the SmarTurbine™ Generator. The methodology proposed is to conduct laboratory experiments to measure rotation rate, rotor blade tip speed, shear stress, pressure changes, turbulence and cavitation associated with the SmarTurbine™ Generator, and then to determine the rate of injury, immediate and direct mortality of various life stages of fish and of invertebrate and zooplankton. The second part of this study request is to conduct field-based fish entrainment surveys within project reaches to characterize the species composition of fish being entrained and to estimate fish entrainment rate(s).

FFP's proposed Entrainment Study is responsive to the information needs expressed in this study request with two notable exceptions.

- FFP is not proposing to study zooplankton or phytoplankton. A history of extensive and intensive studies on conventional power plants indicates that zooplankton and phytoplankton may experience mortality but the primary stressors are thermal elevations and biocide usage, with little effect due to

mechanical stressors. Appropriate references are provided within the Entrainment Study.

- FFP may choose to conduct this experiment in-situ, rather than in a laboratory setting. The controlled injection of fish species at various life stages is a scientifically robust methodology that can be applied in both laboratory and field settings.

FFP believes that the second part of the study proposal, which requests Fish, Drifting Invertebrate and Zooplankton Entrainment Surveys, will only be relevant if the effects of entrainment (injury, direct or delayed mortality) are demonstrably adverse. If the Entrainment Study as proposed by FFP suggests demonstrably adverse impact, FFP will consult with FWS to develop an appropriate survey design.

4.3(d) Riverine Fish Movement Behavior and Habitat Use

FWS proposed a study to provide information on the distribution, movement, habitat use and behavior of fish species of concern to help resource agencies estimate whether and to what extent the project denies important or essential habitat to the species. Methodologies incorporated by this request are Mobile Hydroacoustic Surveys, Telemetry Surveys, and Fixed Hydroacoustic and Sonar Imaging Surveys.

FFP believes that this study request inadequately addresses FERC criterion 5, Nexus to the Project. The nature of baseline data required for an analysis of hydrokinetic generation is necessarily different from the nature of baseline data at conventional hydroelectric generation projects, as unlike in a conventional hydro project, the electrical system is not contained at a single location. Baseline data on species presence or absence from any particular site would fluctuate radically due to variables not linked, either directly or indirectly, to hydrokinetic turbines. Sampling in Project Sites is unlikely to provide useful information relevant to licensing decisions.

In addition, through conversations with scientists with expertise in Mississippi River species and habitat, FFP understands that there have been exhaustive data collection efforts on fish assemblages over large areas of the Mississippi River that have taken place over multiple years that we could not hope to reproduce, without it being cost-prohibitive and taking several years. FFP intends to use these existing data rather than limited sampling within Project Sites.

For this reason, FFP is not adopting this request.

4.3(e) Electromagnetic Stimuli Produced by Hydrokinetic Turbines and their Effects on Riverine Biota

FWS proposed a study to investigate the electromagnetic stimuli produced during the operation of FFP's hydrokinetic turbines and to determine the potential effects of such stimuli on aquatic biota.

FWS's study request proposes that field tests to map the background EMF levels within each lead site and to measure the EMF produced by the turbine and turbines at various depths and locations within each lead site (including lengths 25% of the project length upstream and downstream) for a period of 2years. In the second phase of this study, FWS proposes a literature search to determine potential impacts of measured EMF levels on fish behavior, movement, and habitat use. The third phase is proposed to involve field or lab exposure trials if data does not exist on EM sensitivity or the level of EMF is of concern. Another alternative presented is an analysis of potential impact through virtual trials.

FFP is proposing an EMF study, which is included in Section 6 of this PSP, which is responsive to the information needs outlined in this study request.

FFP is not proposing field measurements of EMF from the SmarTurbine™ Generator system. Typical and worst case EM field stimuli can be conservatively predicted without measurements at project sites.

There is nothing substantially new or different about the SmarTurbine™ Generator system and subsystems in terms of power levels, electrical frequency, and power conversion system configuration compared to several previously studied and reported aquatic-based electrical power systems including offshore wind farms, underwater powerline transmission systems, and other hydrokinetic wave, current and tidal systems.

While the FFP system design and implementation are proprietary to FFP's deployment, the EM effects of the constituent SmarTurbine™ system electric power equipment (generators, power conditioning electronics, and transmission cables) are indistinguishable from well-understood Commercial Technology and associated engineering analysis. Only current, frequency, and power architecture will be required to predict EM fields based on existing study literature (from other Commercial Technology analysis and measurements) and FFP engineering analytical calculations.

Moreover, individual project sites will have no measurable effect on creating unique EM stimuli hence EM stimuli predictions do not need to be made on a site-specific basis but only on an equipment-specific basis. There is no engineering analytical basis or available literature study results that suggest that individual river project sites (e.g. physical geometry of the river, composition of the water, other nearby structures) will measurably increase the EM stimuli produced by the SmarTurbine™ system electric power equipment.

Superposition of EM stimuli from proximate multiple turbines can also be conservatively predicted without measurements at project sites. The superposition of EM fields is well understood analytically. Furthermore, we anticipate the superposition will likely be negligible due to the separation distances of individual EM-generating equipment sources compared to the analytical conservative fall-off amplitude of fields with distance.

FFP agrees with FWS' recommendation that models can predict the EM stimuli of a full-scale build-out, although with the clarification that the basis for the full-scale models, though, will be created from the methods noted above. FFP agrees with FWS' recommendation that EM stimuli effects on riverine fish and other aquatic biota can be determined by literature-based research and through virtual trials, if sensitivity thresholds are exceeded.

4.3(f) Acoustical Stimuli Produced by Hydrokinetic Turbines and their Effects on Riverine Biota

FWS proposed a study to investigate the acoustical stimuli produced during the operation of FFP's hydrokinetic turbines and to determine the potential effects of such stimuli on aquatic biota.

FWS's study request proposes that field tests to map the background acoustical levels within each lead site and to measure the acoustic energy produced by the turbine and turbines at various depths and locations within each lead site (including lengths two times the project length upstream and five times the project length downstream) for a period of 2 years. In the second phase of this study, FWS proposes a literature search to determine potential impacts of acoustic stimuli levels on fish behavior, movement, and habitat use. The third phase is proposed to involve field or lab exposure trials if data does not exist on acoustic energy sensitivity or the level of acoustic energy is of concern. Another alternative presented is an analysis of potential impact through virtual trials.

FFP is proposing an Acoustic Energy study, which is included in Section 6 of this PSP, which is responsive to the information needs outlined in this study request.

In that study proposal, FFP is proposing to measure the acoustic energy produced by a single SmarTurbine™ Generator. FFP is not proposing background or baseline measurements of each Project Site. Individual project sites will have no significant effect on increasing acoustic noise stimuli hence acoustic stimuli predictions do not need to be made on a site-specific basis but only on an equipment-specific basis. There is no engineering analytical basis or available literature study results that suggest that individual river project sites (e.g. physical geometry of the river, composition of the water, other nearby structures) will significantly increase the localized or averaged acoustic noise produced by the SmarTurbine™ system electric power equipment.

While the FFP system design and implementation are proprietary to FFP's deployment, the EM effects of the constituent SmarTurbine™ system electric power equipment (generators, power conditioning electronics, and transmission cables) are indistinguishable from well-understood Commercial Technology and associated engineering analysis. Only current, frequency, and power architecture will be required to predict EM fields based on existing study literature (from other Commercial Technology analysis and measurements) and FFP engineering analytical calculations.

Superposition of acoustic noise from proximate multiple turbines can also be conservatively predicted without measurements at project sites. The superposition of acoustic noise is well understood analytically. Furthermore, we anticipate the superposition will likely be negligible due to the separation distances of individual acoustic noise-generating equipment sources compared to the analytical conservative fall-off amplitude of fields with distance.

FFP agrees with FWS' recommendation that models can predict the EM stimuli of a full-scale build-out, although with the clarification that the basis for the full-scale models, though, will be created from the methods noted above. FFP agrees with FWS' recommendation that EM stimuli effects on riverine fish and other aquatic biota can be determined by literature-based research and through virtual trials, if sensitivity thresholds are exceeded.

4.3(g) Fouling and Debris Loading

FWS proposed a study to provide information about biofouling and debris loading and how they may change flow hydrodynamics in the Mississippi River. The proposal suggests a physical and prototype scale modeling approach to obtain fouling and debris loading information.

Two of FFP's proposed studies, the Hydraulic Study and the Turbine Siting Study, are responsive to the content of this study request.

The Hydraulic study will identify and evaluate potential flow field alterations due to debris and sediment loading. Within the Turbine Siting Study, FFP will evaluate, through literature review, review of anecdotal information and observation and consultation with knowledgeable agency staff, negatively and neutrally buoyant debris transported by the Mississippi River, and its potential impact on turbine deployment.

The drag from a turbine that has become non-operational or is shut-down due to debris loading is, in fact, expected to be *lower* than the drag from an operational turbine - the drag coefficient (drag being defined as energy removal) from an active turbine is between 1.77 and 1.1 *higher* than from a blocked turbine. Therefore, the Hydraulic Study will actually study the upper bounds of hydrodynamic flow field changes.

On the issue of bio-fouling, FFP is exploring a number of chemical and biocidal coatings that will significantly mitigate bio-fouling. This, combined with a maintenance cycle that will clean turbines to optimize generator efficiency, will lead to very minimal effects from bio-fouling.

4.3(h) Species Status Species (except Fish)

FWS proposed a study to provide information on special status species within the project areas through mapping of known occurrences of special status species, identification of

designated critical habitat or potential habitat, conduct of surveys, and development of detailed maps.

FFP's proposed RTE Study, which is included in Section 6 of this PSP, is responsive to the contents of this study request. In that study, FFP is proposing to document any known occurrences of and habitat availability for rare, threatened, and endangered (RTE) species from existing sources, including the resource agencies named in FERC's RTE Survey study request and including the CoE and the USGS.

4.4 National Park Service (NPS), Department of the Interior

On July 14, 2009, the Department of the Interior, filed a letter that outlined one study requests from the NPS.

4.4(a) Comprehensive Recreation Study

NPS proposed a study that would identify and describe the characteristics of recreational use in the vicinity of the Projects and assess the potential impact of project operations on recreational users.

FFP's proposed Commercial Fishing and Recreation Study, which is included in Section 6 of this PSP, is responsive to the information needs contained within this study request.

4.5 US Coast Guard (USCG)

On July 14, 2009, the USCG filed a letter that outlined four study requests, one of which was incorporated by reference to Navigation and Vessel Inspection Circular Number 2-07.

4.5(a) Navigation Study

The USCG proposed an evaluation of the impacts of hydrokinetic project deployment on navigation, including a traffic survey and an assessment of the consequences of altered navigation patterns.

The Navigation Study, proposed by the FERC and adopted by FFP, is responsive to the information need contained within this study request. That study is included as a proposed study plan and is included in Section 6 of this PSP.

4.5(b) Emergency Response Plan

The USCG proposed that FFP should provide an Emergency Response Plan in accordance with NIMS.

This request from the USCG does not fit the description of a formal study request. It does not address FERC's Study Criteria 4, 5, 6 and 7. The USCG has not provided information currently available on this issue or how the study results would inform license requirements. Additionally, USCG has not described the generally accepted practices for obtaining this information, nor has it provided considerations of the levels of effort or cost that would be associated with this study.

FFP commits to working with the USCG to develop an Emergency Salvage Plan, although outside the framework of the Study Plan and period.

4.5(c) Deployment Specifics

The USCG proposed that FFP provide details of the exact location of each piling.

This study request does not address FERC's Study Criteria 4, 5, 6 and 7. The USCG has not provided information currently available on this issue or how the study results would inform license requirements. Additionally, USCG has not described the generally accepted practices for obtaining this information, nor has it provided considerations of the levels of effort or cost that would be associated with this study.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the Turbine Siting Study proposed by the FERC and adopted as to the majority of its elements by FFP will contain information responsive to this study request. That study is included as a proposed study plan and is included in Section 6 of this PSP.

4.5(d) Hydraulic Study

The USCG proposed a study to evaluate potential vertical updrafts caused by varying flows in the Mississippi River.

This study request does not address FERC's Study Criteria 4, 5, 6 and 7. The USCG has not provided information currently available on this issue or how the study results would inform license requirements. Additionally, USCG has not described the generally accepted practices for obtaining this information, nor has it provided considerations of the levels of effort or cost that would be associated with this study.

Therefore, FFP does not consider this a compliant study request. Nevertheless, FFP's Hydraulic Study is responsive to the content of this study request. That study is included as a proposed study plan and is included in Section 6 of this PSP.

4.6 Tennessee Wildlife Resources Agency (TWRA)

On July 13, 2009, the Tennessee Wildlife Resources Agency filed a letter that outlined three informal study requests. FFP does not consider these as compliant study requests, and two of the three matters are recommendations for inclusion in the EIS.

4.6(a) Habitat Alteration

TWRA requests that the EIS include a study examining the impact of the turbines on fish habitats. TWRA acknowledges that FFP has already indicated that it will study impacts on the fish themselves, and this request stresses the need for a study on the impact on the habitats of these fish.

This study request does not address FERC's Study Criteria 4, 5, 6, and 7. TWRA has not provided information currently available concerning fish habitats, nor has it provided information describing the ways in which it fears those habitats may be disturbed by turbines or how the study results would inform license requirements. Additionally, TWRA has not described the generally accepted practices for obtaining this information, nor has it provided considerations of the levels of effort or cost that would be associated with this study.

Therefore, FFP does not consider this a compliant study request. The issues raised by this informal study request will nevertheless be addressed by the following Applicant Proposed Study Plans:

- Hydraulic Study
- Electromagnetic Field Study
- Acoustic Energy Study
- RTE Study

4.6(b) Impact to Recreational and Commercial Fisheries

TWRA is concerned that the presence of turbines in the water will render those stretches of river in which turbines are located impracticable for future commercial and recreational fishing. TWRA therefore requests that FFP conduct a study to determine the economic impact that the elimination of fishing in these waters will have.

This request does not address FERC criteria 2, 4, 6, and 7. TWRA has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. The issues raised by this informal study request will, nevertheless, be addressed by FFP's Commercial Fishing and Recreation Study.

4.6(c) Impact to Commercial and Recreational Navigation

The TWRA requests that FFP conduct a study to determine what impact, if any, its projects will have on commercial and recreational navigation vessels.

This request does not address FERC criteria 2, 4, 6, and 7. TWRA has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. The issues raised by this informal study request will nevertheless be addressed by the following Applicant Proposed Study Plans:

- Hydraulic Study
- Navigation Study
- Commercial Fishing and Recreation Study

4.7 Mississippi Department of Wildlife, Fisheries and Parks

On April 13, 2009, the Mississippi Department of Wildlife, Fisheries and Parks filed a letter that outlined four informal study requests.

4.7(a) Effect on Commercial Fisheries

The Mississippi Department of Wildlife, Fisheries and Parks proposed a study to assess the potential impact of hydrokinetic development on commercial fisheries.

This request does not address FERC criteria 2, 4, 6, and 7. The Mississippi Department of Wildlife, Fisheries and Parks has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the effect FFP's Projects on commercial fishing will be addressed by FFP's proposed Commercial Fishing and Recreation Study, which is included in Section 6 of this PSP.

4.7(b) Recreational Fisheries

The Mississippi Department of Wildlife, Fisheries and Parks proposed a study to determine whether recreational fishermen would be excluded from areas of hydrokinetic deployment.

This request does not address FERC criteria 2, 4, 6, and 7. The Mississippi Department of Wildlife, Fisheries and Parks has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this informal study request will be addressed by FFP's Commercial Fishing and Recreation Study, which is included in Section 6 of this PSP.

4.7(c) Eco-tourism

The Mississippi Department of Wildlife, Fisheries and Parks proposed a study to determine how hydrokinetic project development would affect the aesthetics of the Lower Mississippi River, especially as it pertains to eco-tourism on undeveloped batture lands.

This request does not address FERC criteria 2, 4, 6, and 7. The Mississippi Department of Wildlife, Fisheries and Parks has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this informal study request will be addressed by FFP's Commercial Fishing and Recreation Study, which is included in Section 6 of this PSP.

4.7(d) Timber Harvest

The Mississippi Department of Wildlife, Fisheries and Parks proposed a study to assess the potential impact of hydrokinetic development on timber harvest, especially as it pertains to the location of power lines and shore facilities in areas that may be used for loading timber onto barges.

This request does not address FERC criteria 2, 4, 6, and 7. The Mississippi Department of Wildlife, Fisheries and Parks has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

For these reasons, FFP is not proposing to adopt this study request.

4.8 Illinois Department of Natural Resources

On April 30, 2009, the Illinois Department of Natural Resources filed a letter that outlined seven informal study requests.

4.8(a) Fish Entrainment

The Illinois DNR proposed a study to assess the likelihood of fish entrainment, probable injury and mortality levels of fish passing through the turbines.

This request does not address FERC criteria 2, 4, 6, and 7. The Illinois DNR has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this informal study request will be addressed by FFP's Fish Entrainment Study, which is included in Section 6 of this PSP.

4.8(b) Mussel Surveys

The Illinois DNR proposed a study to survey each site for the presence of freshwater mussels.

This request does not address FERC criteria 2, 4, and 7. The Illinois DNR has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, or levels of effort and cost.

Moreover, the US Fish & Wildlife Service, in its comments filed by the US Department of the Interior, specifically notes that "we have not identified the need to specifically identify the location of mussel beds or fish spawning locations. This is based on the understanding that the turbines are proposed to be placed within deep, fast flowing water areas which are generally not considered habitat for mussel beds….For example, within the lower Mississippi River, known mussel beds occur within dike fields and side channels. Mussel populations are sparse in the Middle Mississippi River, but are known to occur in side channels."

Therefore, we believe that this non-compliant study request also fails to address FERC criterion 5, Nexus to the Project.

For these reasons, FFP is not adopting this study request.

4.8(c) Electromagnetic Fields

The Illinois DNR proposed a study to evaluate implications of potential EMF generation by FFP's hydrokinetic arrays.

This request does not address FERC criteria 2, 4, 6, and 7. The Illinois DNR has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this informal study request will be addressed by FFP's EMF Study, which is included in Section 6 of this PSP.

4.8(d) Sediment Deposition and Flow

The Illinois DNR proposed a study to evaluate implications of potential FFP Projects' potential effects on flow patterns and sediment transport.

This request does not address FERC criteria 2, 4, 6, and 7. The Illinois DNR has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this informal study request will be addressed by FFP's Hydraulic Study, which is included in Section 6 of this PSP.

4.8(e) Wetlands Impacts

The Illinois DNR proposed a study to evaluate effects of FFP Projects on wetlands.

This request does not address FERC criteria 2, 4, 6, and 7. The Illinois DNR has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this informal study request will be addressed by FFP's Vegetation, Wildlife Habitat and Noxious Weeds Inventory, which is included in Section 6 of this PSP.

4.8(f) Terrestrial Habitat Effects

The Illinois DNR is requesting the identification of sites where disturbance of terrestrial habitats might occur during construction or maintenance.

This request it does not address FERC criteria 2, 4, 6, and 7. The Illinois DNR has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

In addition, FFP believes that the Illinois DNR has not clearly addressed FERC criterion 5, Nexus to the Project, because it is not clear how the results of this study would inform the development of license requirements.

Therefore, FFP does not consider this a compliant study request. Nevertheless, some of the issues raised by this informal study request will be addressed by FFP's Vegetation, Wildlife Habitat and Noxious Weeds Inventory, which is included in Section 6 of this PSP.

4.8(g) Conflicts with Commercial and Recreational Fishing

The Illinois DNR proposed that the impacts to recreational and commercial fishing be included in FERC's EIS.

This study request is explicitly described as a matter for the EIS, rather than for the PSP. In addition, it does not address FERC criteria 2, 4, 6, and 7. The Illinois DNR has not

described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. The impact of FFP Projects on commercial and recreational fishing raised by this informal study request will, nevertheless, be addressed by FFP's Commercial Fishing and Recreation Study, which is included in Section 6 of this PSP.

4.9 The Department of Arkansas Heritage

On June 25, 2009, the Department of Arkansas Heritage filed a letter that contains an informal study request.

4.9(a) Cultural Resource Survey

The Department of Arkansas Heritage recommends a cultural resource survey for all areas where ground disturbance is proposed.

This request does not address FERC criteria 2, 4, 6, and 7. The Department of Arkansas Heritage has not described the relevant resource management goals, existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. The issues raised by this informal study request will, nevertheless, be addressed by FFP's Archeologic and Historic Resource Survey, which is included in Section 6 of this PSP.

4.10 American Waterways Operators (AWO)

On July 14, 2009, the AWO filed a letter that included three informal study requests.

4.10(a) Hydraulic Study

The AWO proposed a study that would assess the impact the turbines and associated equipment would have on the integrity of structures that maintain the navigation channel and protect against flooding. The proposal also suggests that the study include an evaluation of "resultant scouring and silting in the channel and potential damage to all engineering structures and navigation, dredging, dredge [*sic*] material disposal, bank erosion and sediment transport."

This request does not address FERC criteria 4, 6 and 7. AWO has not described existing information about the study proposal, the need for additional information, methodologies, or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this request will be addressed by FFP's Hydraulic Study, which is included in Section 6 of this PSP.

4.10(b) Spatial Study

The AWO proposed a study that would address the spatial need of inland tows.

This request does not address FERC criteria 4, 5, 6 and 7. AWO has not described existing information about the study proposal, the need for additional information, methodologies or levels of effort and cost. In addition, the Nexus to the Project is also deficiently treated, including a lack of information about how study results would inform the development of license requirements.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this request will be addressed by the Turbine Siting and Navigation Studies. These study plans are included in Section 6 of this PSP.

4.10(c) Electric Current Study

The AWO proposed a study that would investigate potential harm to personnel and cargo from electrical current generated by hydrokinetic turbine deployment.

This request does not address FERC criteria 6 and 7. AWO has not described study methodologies or any levels of effort and cost. Also, FERC criterion 4, Existing Information, is very cursorily treated. While there is a reference to a study done of the Illinois Waterway, there is no discussion of the extensive literature about and research into underwater electrical field generation and propagation.

Therefore, FFP does not consider this a compliant study request. Nevertheless, the issues raised by this request will be addressed by FFP's EMF Study, which is included in Section 6 of this PSP.

4.11 State of Missouri Department of Natural Resources (MO DNR)

On July 14, 2009, the MO DNR filed a letter that included eight informal study requests.

4.11(a) River Morphology and Sediment Transport Study

The MO DNR proposes a study to evaluate the specific and cumulative impacts its hydrokinetic Projects will have on flow regimes and sediment transport, and endorses the study requests on this subject submitted by the FERC and the CoE.

This request does not address FERC Criterion 7, Level of Effort and Cost.

As with the FERC's and the CoE's study requests on geomorphology and sediment transport, FFP's Hydraulic Study will address the content of this study request. That study is included in Section 6 of this PSP.

4.11(b) Seismic Issues

The MO DNR recommends that FFP review information on maximum projected acceleration related to a potential large magnitude earthquake in the Wabash Valley or New Madrid Seismic Zones and integrate design characteristics that would withstand such an event.

This request does not address FERC criteria 4, 6, and 7. MO DNR has not provided existing information regarding the region's vulnerability to earthquakes, nor has it provided information or sources of information that may have previously been gathered about the effects of earthquakes on the Mississippi River main stem. Additionally, this request does not address methodologies, generally accepted study practices or levels of effort and cost.

Therefore, FFP does not consider this a compliant study request and is not proposing a study of this issue.

4.11(c) Habitat and Aquatic Issues

The MO DNR supports recommendations of the MO Department of Conservation and recommends studies be done to determine potential injury to aquatic species through entrainment or habitat alteration.

This request does not address FERC criteria 4, 6, and 7. MO DNR has not provided any existing information about this issue or addressed methodologies, generally accepted study practices of levels of effort and cost.

Therefore, FFP does not consider this a compliant study request. The content of this study request will be addressed by FFP's Entrainment and Hydraulic Studies, both of which are included in Section 6 of this PSP.

4.11(d) Water Quality and Permitting

The MO DNR also clarified Missouri state law pertaining to issues of water quality and provided FFP with guidance on certain aspects of such state law.

This is not a study request. It does not address any of the FERC study criteria.

Therefore, FFP is not adopting a study plan on this request.

4.11(e) Financial Assurance

The MO DNR recommended that FFP provide plans and financial commitments to ensure project removal in case of failure or termination.

This is not a study request. It does not address any of the FERC study criteria.

Therefore, FFP is not adopting a study plan on this request.

4.11(f) Installation, Operation and Maintenance

The MO DNR noted its support of the study requests filed by the FERC and the CoE pertaining to environmental impacts during installation, operation and maintenance.

This is not a study request. It does not address any of the FERC study criteria.

The issues raised by this part of MO DNR's letter will be addressed by Turbine Siting Study and the Navigation Study. These proposed study plans are included in Section 6 of this PSP.

4.11(g) Parks and Recreation Issues

The MO DNR noted its support of the study request filed by the FERC pertaining to recreational resources.

This is not a study request. It does not address any of the FERC study criteria.

The content of this informal request will be addressed by Commercial Fishing and Recreation Study proposed by FFP. That proposed study plan is included in Section 6 of this PSP.

4.11(h) Cultural resources

The MO DNR noted that the State Historic Preservation Office is housed within the Department should be consulted in connection with Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's regulations.

This is not a study request. It does not address any of the FERC study criteria.

The consultation requirement addressed in this section of MO DNR's letter is addressed in the Archeological and Historic Resource Survey proposed by FFP. That proposed study plan is included in Section 6 of this PSP.

4.12 US Environmental Protection Agency (EPA)

In a letter dated July 8, 2009, the EPA filed a number of recommendations for inclusion in the EIS and five informal study requests.

4.12(a) Sediment Deposition

EPA requests that FFP assess potential for scouring and silting close to channel and flood control infrastructure, as stated in SD1. In addition, EPA recommends FFP study the potential for habitat alteration and increased sedimentation, as provided for in FFP's Pre-Application Document. EPA recommends that FFP conduct upstream/downstream monitoring at an ILP site or use an existing model to determine net effect to turbidity.

This request does not adequately address FERC criteria 5, 6 and 7. EPA has not described how the study results would inform the development of license requirements or levels of cost and effort. In addition, while EPA provides a recommendation to conduct upstream/downstream modeling, it does not explain why this is a preferred study methodology or why FFP's proposed alternative study would not be sufficient to meet stated information needs.

Therefore, FFP does not consider this a compliant study request. FFP's proposed Hydraulic Study addresses the issue of sediment transport and is included in Section 6 of this PSP.

4.12(b) Aquatic Species – Entrainment, EMF, Noise/Vibration

EPA requests that FFP conduct in-situ research on potential impacts to aquatic species, including fish entrainment and impingement, EMF, and noise/vibration.

This request does not adequately address FERC criteria 6 and 7. EPA has not described how the study results would inform the development of license requirements or levels of cost and effort.

Therefore, FFP does not consider this a compliant study request. Nevertheless, FFP has proposed three studies that are responsive to these concerns:

- Fish Entrainment Study
- Electromagnetic Field Study
- Acoustic Energy Study

These plans are included in Section 6 of this PSP.

4.12(c) Aquatic Species – Riverbed Survey

EPA proposes that FFP survey the riverbed for rare species, particularly mussels and their host species.

This request does not adequate address FERC criteria FERC criteria 5, 6 and 7. EPA has not described how the study results would inform the development of license requirements or levels of cost and effort. In addition, EPA highlights the need to survey for mussels.

The US Fish & Wildlife Service, in its comments filed by the US Department of the Interior, specifically notes that "we have not identified the need to specifically identify the location of mussel beds or fish spawning locations. This is based on the understanding that the turbines are proposed to be placed within deep, fast flowing water areas which are generally not considered habitat for mussel beds….For example, within the lower Mississippi River, known mussel beds occur within dike fields and side channels. Mussel populations are sparse in the Middle Mississippi River, but are known to occur in side channels."

Concern for the presence of other RTE species will be addressed by FFP's proposed RTE Study, which is included in Section 6 of this PSP.

4.12(d) Indirect Impacts

EPA requests a study to analyze the extent to which new power generation would "potentially contribute to indirect impacts resulting from the expansion of existing users or new development along the banks of the Mississippi River connected to power supplied by FFP's projects, particularly induced development within the floodplain."

This request does not adequately address FERC criteria 4, 6, or 7. EPA has not provided any existing information about this issue, proposed any study methodologies, or explained considerations of levels of effort or cost. In addition, Criterion 5, Nexus to the Project, is also not adequately satisfied. It is not clear how study results would inform the results of license requirements.

Therefore, FFP does not consider this a compliant study request and is not adopting it.

4.12(e) Hydrologic Modeling

EPA requests detailed hydrodynamic modeling to assess the cumulative effects of Project operations on the natural flow regimen of the river.

This request does not adequately address FERC criteria 4 or 7. EPA has not provided any existing information about this issue or explained considerations of levels of effort or cost. In addition, Criterion 5, Nexus to the Project, is also not adequately satisfied. It is not clear how study results would inform the results of license requirements.

Therefore, FFP does not consider this a compliant study request. Nevertheless, FFP is proposing a Hydraulic Study that proposes the development of hydrodynamic models that

address the content of this study request. That proposed study plan is included in Section 6 of this PSP.

4.13 Missouri Department of Conservation (MDC)

On July 14, the MDC filed a letter with the FERC supporting study requests proposed by the FERC staff and by the US Department of the Interior, US Fish and Wildlife Service and submitted a study request of its own.

4.13.a Angler and Commercial Fishing Survey and other Recreational Use Survey and Evaluation

MDC proposed a study evaluating project effects on recreational use and commercial fishing by identifying and describing recreational use and commercial fishing interests within the Project Sites in order to identify possible overlap of competing interests.

The content of the Commercial Fishing and Recreation Study proposed by FFP will address the issues raised in this study request and is included in Section 6 of this PSP.

4.14 Prairie Rivers Network (PRN), Gulf Restoration Network (GRN), and the Illinois Chapter of the Sierra Club

On July 14, PRN, GRN and the Illinois chapter of the Sierra Club filed a letter that outlined seven study requests, six of which are requests that were also submitted by the FWS.

4.14(a) Effect of Acoustical Stimuli Produced by Hydrokenetic [sic] Turbines on Riverine Biota

PRN, GRN and the Illinois chapter of the Sierra Club proposed a study to investigate the acoustical stimuli produced during the operation of FFP's hydrokinetic turbines and to determine the potential effects of such stimuli on aquatic biota.

PRN, GRN and the Illinois chapter of the Sierra Club's study request proposes that field tests to map the background acoustical levels within each lead site and to measure the acoustic energy produced by the turbine and turbines at various depths and locations within each lead site (including lengths two times the project length upstream and five times the project length downstream) for a period of 2 years. In the second phase of this study, PRN, GRN and the Illinois chapter of the Sierra Club propose a literature search to determine potential impacts of acoustic stimuli levels on fish behavior, movement, and habitat use. The third phase is proposed to involve field or lab exposure trials if data does not exist on EM sensitivity or the level of EMF is of concern. Another alternative presented is an analysis of potential impact through virtual trials.

FFP is proposing an Acoustic Energy study, which is included in Section 6 of this PSP, which is responsive to the information needs outlined in this study request.

In that study proposal, FFP is proposing to measure the acoustic energy produced by a single SmarTurbine™ Generator. FFP is not proposing background or baseline measurements of each Project Site. Individual project sites will have no significant effect on increasing acoustic noise stimuli hence acoustic stimuli predictions do not need to be made on a site-specific basis but only on an equipment-specific basis. There is no engineering analytical basis or available literature study results that suggest that individual river project sites (e.g. physical geometry of the river, composition of the water, other nearby structures) will significantly increase the localized or averaged acoustic noise produced by the SmarTurbine™ system electric power equipment.

While the FFP system design and implementation are proprietary to FFP's deployment, the EM effects of the constituent SmarTurbine™ system electric power equipment (generators, power conditioning electronics, and transmission cables) are indistinguishable from well-understood Commercial Technology and associated engineering analysis. Only current, frequency, and power architecture will be required to predict EM fields based on existing study literature (from other Commercial Technology analysis and measurements) and FFP engineering analytical calculations.

Superposition of acoustic noise from proximate multiple turbines can also be conservatively predicted without measurements at project sites. The superposition of acoustic noise is well understood analytically. Furthermore, we anticipate the superposition will likely be negligible due to the separation distances of individual acoustic noise-generating equipment sources compared to the analytical conservative fall-off amplitude of fields with distance.

FFP agrees with FWS' recommendation that models can predict the EM stimuli of a full-scale build-out, although with the clarification that the basis for the full-scale models, though, will be created from the methods noted above. FFP agrees with FWS' recommendation that EM stimuli effects on riverine fish and other aquatic biota can be determined by literature-based research and through virtual trials, if sensitivity thresholds are exceeded.

4.14(b) Fouling and Debris Loading

PRN, GRN and the Illinois chapter of the Sierra Club proposed a study to provide information about biofouling and debris loading and how they may change flow hydrodynamics in the Mississippi River. The proposal suggests a physical and prototype scale modeling approach to obtain fouling and debris loading information.

Two of FFP's proposed studies, the Hydraulic Study and the Turbine Siting Study, are responsive to the content of this study request.

The Hydraulic study will identify and evaluate potential flow field alterations due to debris and sediment loading. Within the Turbine Siting Study, FFP will evaluate, through literature review, review of anecdotal information and observation and consultation with knowledgeable agency staff, negatively and neutrally buoyant debris transported by the Mississippi River, and its potential impact on turbine deployment.

The drag from a turbine that has become non-operational or is shut-down due to debris loading is, in fact, expected to be *lower* than the drag from an operational turbine. Therefore, the Hydraulic Study will actually study the upper bounds of hydrodynamic flow field changes.

On the issue of bio-fouling, FFP is exploring a number of chemical and biocidal coatings that will significantly mitigate bio-fouling. This, combined with a maintenance cycle that will clean turbines to optimize generator efficiency, will lead to very minimal effects from bio-fouling.

4.14(c) Riverine Fish and Aquatic Invertebrate Entrainment and Mortality

PRN, GRN and the Illinois chapter of the Sierra Club proposed a study to determine the nature and extent of fish, invertebrate and zooplankton injury, direct and delayed mortality as a result of passage through the SmarTurbine™ Generator. The methodology proposed is to conduct laboratory experiments to measure rotation rate, rotor blade tip speed, shear stress, pressure changes, turbulence and cavitation associated with the SmarTurbine™ Generator, and then to determine the rate of injury, immediate and direct mortality of various life stages of fish and of invertebrate and zooplankton. The second part of this study request is to conduct field-based fish entrainment surveys within project reaches to characterize the species composition of fish being entrained and to estimate fish entrainment rate(s).

FFP's proposed Entrainment Study is responsive to the information needs expressed in this study request with two notable exceptions.

- FFP is not proposing to study zooplankton or phytoplankton. A history of extensive and intensive studies on conventional power plants indicates that zooplankton and phytoplankton may experience mortality but the primary stressors are thermal elevations and biocide usage, with little effect due to mechanical stressors. Appropriate references are provided within the Entrainment Study.
- FFP may choose to conduct this experiment in-situ, rather than in a laboratory setting. The controlled injection of fish species at various life stages is a scientifically robust methodology that can be applied in both laboratory and field settings.

FFP believes that the second part of the study proposal, which requests Fish, Drifting Invertebrate and Zooplankton Entrainment Surveys, will only be relevant if the effects of entrainment (injury, direct or delayed mortality) are demonstrably adverse. If the

Entrainment Study as proposed by FFP suggests demonstrably adverse impact, FFP will consult with FWS to develop an appropriate survey design.

4.14(d) Hydraulic Effects

PRN, GRN and the Illinois chapter of the Sierra Club requested a hydraulic study whose objective is to provide information about changes in hydrodyanamics potentially caused by FFP Projects and the effect of these changes on aquatic biota.

FFP's Hydraulic Study addresses the issues raised by this study request.

Two notable differences in methodology are proposed by FFP in its Hydraulic Study.

- FFP is not proposing to study zooplankton or phytoplankton. A history of extensive and intensive studies on conventional power plants indicates that zooplankton and phytoplankton may experience mortality but the primary stressors are thermal elevations and biocide usage, with little effect due to mechanical stressors. Appropriate references are provided within the Hydraulic Study.
- FFP proposes to use a depth-integrated two-dimensional model to perform a number of functions within the study. Although some of those functions are not specifically of interest to the PRN, GRN and the Illinois chapter of the Sierra Club or the FWS, several are responsive to issues raised within this study request, including:
  - Create boundary conditions for the 3D river model. This will be the distribution of flow and sediment concentration at the upstream boundary of the 3D river model.
  - Horizontal depth-averaged currents, concentration, and bed changes will be calculated over a seasonal time period.
  - Assess impact of hydrokinetic deployment on sediment and currents, particularly those that are far away.

This methodology is consistent with generally accepted practice within the scientific community and references are provided within the Hydraulic Study, included in Section 6 of this PSP.

4.14(e) Electromagnetic Stimuli Produced by Hydrokinetic Turbines and their Effects on Riverine Biota

PRN, GRN and the Illinois chapter of the Sierra Club proposed a study to investigate the electromagnetic stimuli produced during the operation of FFP's hydrokinetic turbines and to determine the potential effects of such stimuli on aquatic biota.

PRN, GRN and the Illinois chapter of the Sierra Club's study request proposes that field tests to map the background EMF levels within each lead site and to measure the EMF produced by the turbine and turbines at various depths and locations within each lead site

(including lengths 25% of the project length upstream and downstream) for a period of 2years. In the second phase of this study, PRN, GRN and the Illinois chapter of the Sierra Club proposes a literature search to determine potential impacts of measured EMF levels on fish behavior, movement, and habitat use. The third phase is proposed to involve field or lab exposure trials if data does not exist on EM sensitivity or the level of EMF is of concern. Another alternative presented is an analysis of potential impact through virtual trials.

FFP is proposing an EMF study, which is included in Section 6 of this PSP, which is responsive to the information needs outlined in this study request.

FFP is not proposing field measurements of EMF from the SmarTurbine^{TM} Generator system. Typical and worst case EM field stimuli can be conservatively predicted without measurements at project sites.

There is nothing substantially new or different about the SmarTurbine^{TM} Generator system and subsystems in terms of power levels, electrical frequency, and power conversion system configuration compared to several previously studied and reported aquatic-based electrical power systems including offshore wind farms, underwater powerline transmission systems, and other hydrokinetic wave, current and tidal systems.

While the FFP system design and implementation are proprietary to FFP's deployment, the EM effects of the constituent SmarTurbine™ system electric power equipment (generators, power conditioning electronics, and transmission cables) are indistinguishable from well-understood Commercial Technology and associated engineering analysis. Only current, frequency, and power architecture will be required to predict EM fields based on existing study literature (from other Commercial Technology analysis and measurements) and FFP engineering analytical calculations.

Moreover, individual project sites will have no measurable effect on creating unique EM stimuli hence EM stimuli predictions do not need to be made on a site-specific basis but only on an equipment-specific basis. There is no engineering analytical basis or available literature study results that suggest that individual river project sites (e.g. physical geometry of the river, composition of the water, other nearby structures) will measurably increase the EM stimuli produced by the SmarTurbine™ system electric power equipment.

Superposition of EM stimuli from proximate multiple turbines can also be conservatively predicted without measurements at project sites. The superposition of EM fields is well understood analytically. Furthermore, we anticipate the superposition will likely be negligible due to the separation distances of individual EM-generating equipment sources compared to the analytical conservative fall-off amplitude of fields with distance.

FFP agrees with FWS' recommendation that models can predict the EM stimuli of a full-scale build-out, although with the clarification that the basis for the full-scale models, though, will be created from the methods noted above. FFP agrees with FWS'

recommendation that EM stimuli effects on riverine fish and other aquatic biota can be determined by literature-based research and through virtual trials, if sensitivity thresholds are exceeded.

4.14(f) Species Status Species (except Fish)

PRN, GRN and the Illinois chapter of the Sierra Club proposed a study to provide information on special status species within the project areas through mapping of known occurrences of special status species, identification of designated critical habitat or potential habitat, conduct of surveys, and development of detailed maps.

FFP's proposed RTE Study, which is included in Section 6 of this PSP, is responsive to the contents of this study request.

4.14(g) Additional Hydraulic Study

PRN, GRN and the Illinois Chapter of the Sierra Club request a study examining project effects on flow-velocity field, sediment Flux and channel morphology.

FFP's Hydraulic Study, which is included in Section 6 of this PSP, is responsive to the contents of this study request.

SECTION 5

PROPOSED PROCESS PLAN &
STUDY PLAN MEETINGS SCHEDULE

SECTION 5 STUDY MEETINGS, TLP JOINT AGENCY MEETINGS & PROPOSED PROCESS PLAN

In accordance with 18 CFR § 5.11(6)(e), FFP proposes to hold four study meetings to clarify the PSP and resolve any outstanding issues with respect to FFP's proposed licensing studies.

Each Study Meeting will cover all of FFP's proposed studies and the topics of interest in each one. In addition, each Study Meeting will have a "featured topic" that will be examined in detail.

The schedule of meetings is as follows:

- September 28 and 29, 2009
  Featured Topic: Navigation, Sedimentation, Geomorphology

- October 6 and 7, 2009
  Featured Topic: Aesthetics, Cultural, Recreational Resources

- October 13 and 14, 2009
  Featured Topic: Fisheries, Aquatic biota and Habitat

- October 20 and 21, 2009
  Featured Topic: Wetlands and Terrestrial Resources

FFP will also hold a Joint Agency Meeting for its TLP sites on the second afternoon of each block of meeting times, as in the schedule below:

- September 29, 2009 afternoon

- October 7, 2009 afternoon

- October 14, 2009 afternoon

- October 21, 2009 afternoon

Details for each meeting (venue, timing, etc.) will be provided in a subsequent filing with the Commission.

FFP is also proposing the Process Plan after accounting for the extension to July 14, 2009 that was granted for the submission of Study Requests. This Process Plan is on the following page.

Free Flow Power Corporation
Lead Projects Process Plan and Schedule

Responsible Party	Pre-Filing Milestone	Date
All stakeholders	PAD/SD1 Comments and Study Requests Due	7/14/09
FERC	Issue Scoping Document	8/28/09
FFP	File Proposed Study Plan (PSP)	8/28/09
All stakeholders	Study Plan Meetings	September and October
Joint Agency Meeting for TLP Projects to be Held in Conjuncstion with Study Plan Meetings		
All stakeholders	Comments on Proposed Study Plan Due	11/27/09
FFP	File Revised Study Plan	12/28/09
All stakeholders	Revised Study Plan Comments Due	1/12/10
FERC	Director's Study Plan Determination	1/27/10
All Mandatory Conditioning Agencies	Any Study Disputes Due	2/16/10
Dispute Resolution Process, if necessary. Schedule to be adjusted accordingly		
FFP	First Study Season	2010
FFP	Initial Study Report	10/26/10
All stakeholders	Initial Study Report Meeting	11/10/10
FFP	Initial Study Report Meeting Summary	11/26/10
Second Study Season, if necessary. Schedule to be adjusted accordingly		
FFP	File Preliminary Licensing Proposal	8/17/10
All stakeholders	Preliminary Licensing Proposal Comments Due	11/15/10
FFP	File Final License Application	12/31/10

SECTION 6

APPLICANT PROPOSED STUDY PLANS

TURBINE SITING STUDY

This study is site-specific.

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

August 2009

Prepared by:
Free Flow Power Corporation

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ABSTRACT

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Mississippi River Projects ("TLP Projects"). The ILP and the TLP Projects are collectively referred to as the FFP Projects.

FFP is proposing a study to identify locations within each FFP Project Site that are the most appropriate for deploying turbines. The study will also determine the optimal number of turbines to be deployed at each project site.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

This PSP Document is being submitted in connection with the ILP process for the seven Lead Projects, with the intention that

A. Study design for all studies will be applicable to most or all studies conducted for FFP Projects, and
B. Results for certain studies, which are to be conducted on a limited number of ILP Projects or on a site-independent basis (e.g., in a test tank), will be applicable to all FFP Projects.

The location of each FFP Project by state and river miles is presented below:

ILP Projects

		River Mile	
Project	**State(s)**	**Start**	**End**
Greenville Bend	LA	99.1	102.0
Scotlandville Bend	LA	233.9	236.9
Kempe Bend	LA/MS	381.1	386.5
Ashley Point	MS/AR	679.1	695.5
Hope Field Point	AR/TN	725.0	736.9
Flora Creek Light	MO/IL	51.2	58.0
McKinley Crossing	MO/IL	182.1	184.1

TLP Projects

Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8
Fashion Light	LA	121.5	126.5

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Thirty Five Mile Point	LA	128.3	130.9
Woodland Light	LA	132.4	136.5
Forty Eight Mile	LA	139.5	146.2
Remy Bend	LA	149.8	152.2
College Point	LA	155.5	157.8
Brilliant Point	LA	160.8	166.4
General Hampton	LA	168.3	174.5
Eighty One Mile Point	LA	175.5	182.0
Claiborne Island	LA	184.2	188.2
White Alder	LA	191.2	196.4
Point Pleasant	LA	197.9	201.0
Reliance Light	LA	205.7	210.8
Manchac Point	LA	213.9	218.4
Duncan Point	LA	219.5	224.0
Sara Bend	LA	262.3	266.2
Morgan Bend Crossing	LA	274.9	283.5
Newton Bend	LA/MS	417.8	427.4
Milliken Bend	LA/MS	451.9	461.9
Cat Island	LA/MS	493.6	500.0
Anconia Point	MS/AR	530.1	531.8
Walker Bend	MS/AR	532.8	537.4
Malone Field Light	MS/AR	582.1	591.5
Helena Reach	MS/AR	662.4	669.0
Plum Point	AR/TN	776.5	788.9
Bar Field Bend	AR/TN	804.7	814.5
Huffman Light	AR/TN	822.8	826.5
Little Prairie Bend	TN/MO	846.5	851.9
Williams Point	TN/MO	873.0	880.9
New Madrid Bend	MO/KY	883.0	893.0
Hickman Bend	MO/KY	917.9	923.8
Wickliffe	MO/KY	950.0	952.9
Greenfield Bend	MO/IL	1.0	9.5
Gale Light	MO/IL	43.5	46.8
Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
Arsenault Island	MO/IL	176.5	180.4
Wilson Island	MO/IL	188.5	195.5
Mobile Island	MO/IL	196.4	198.2

1.2 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has

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This PSP is being filed pursuant to FERC regulations issued on July 23, 2003 for the ILP (18 CFR Part 5). Relevant state and federal agencies, Indian tribes, non-governmental organizations, and the general public will participate in the FFP Projects ILP. During the ILP, information needs for the licensing process will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b), which states that any information or study request must:

A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
C. If the requester is not an a resource agency, explain any relevant public interest considerations in regard to the proposed study;
D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of the study is to determine the number and location of turbines that can be deployed at each site without adversely affecting other important river uses and resources.

The specific objectives of the study are to:

- Determine a maximum elevation for turbine infrastructure selected to avoid adverse effects on navigation
- Determine a minimum clearance from the bottom to limit the potential for accumulation of large debris
- Evaluate other constraints that may limit the number or location of turbines that can be deployed at each site.

SECTION 3 STUDY AREA

This study will be conducted about each FFP Project Site.

SECTION 4 BACKGROUND & EXISTING INFORMATION

FFP proposes to deploy hydrokinetic turbines in 55 proposed Project Sites. South of Baton Rouge, where the navigation channel is maintained to a depth of 45 feet with authorization for 55 feet, FFP proposes that all underwater infrastructure will be placed at a minimum of 45 feet below the Low Water Reference Plane (LWRP), with an agreement to lower the height of the infrastructure to 55 feet below the LWRP if the channel depth is increased in the future. In the shallow-draft portion of the river, which is north of Baton Rouge, the navigation channel is maintained to a depth of 9 feet. Barges do draft deeper than 9 feet in this region, and FFP understands that 15 feet may be a more likely minimum depth below the LWRP where underwater infrastructure would be deployed.

Other than navigation, competing uses include dredging and fleeting. The Study Request from the CoE on Fleeting and Commercial Dredging Competing Uses provided the following information on fleeting and commercial dredging:

In-stream anchor fleets utilize heavy lengths of chain connected to anchors that lie on the river bottom to securely moor fleets of empty and full barges floating in the open river channel. The anchors and chains require periodic lateral movement to alter fleet location distances from the riverbank and the navigation channel with changing river elevations. Operators of existing fleeting operations periodically request permits to expand fleets based on business needs and proximity to related river terminal operations.

Commercial sand and gravel dredging operations are typically permitted for 20 to 100 river mile reaches to allow the dredgers to find clean sand and gravel deposits for dredging.

SECTION 5 PROJECT NEXUS

Determining proper elevations of the turbines will allow safe passage of vessels over the turbine fields. Additionally, in order not to impede previously permitted competing uses of the Mississippi River, FFP will have to locate the extent of such uses, such as commercial sand dredging and fleeting.

SECTION 6 METHODOLOGY

FFP will consult with the Corps of Engineers while conducting this study. FFP proposes the following methodology for the study:

A. Create bathymetric maps of FFP Project Sites based on the most current and detailed existing information
B. Identify areas of major bathymetric changes by comparing the most recent bathymetric information to historic bathymetric information
C. Determine the minimum water depth above turbine infrastructure that is needed to avoid affecting navigation at each FFP Project Site, and provide the basis of these calculation
D. Determine the lowest water surface elevation that has occurred in the period of record at each FFP Project Site
E. Establish an appropriate margin of safety, considering the potential for future hydrological variations, to avoid interference with navigation and to take into consideration any other relevant safety or operational concerns
F. Based on the above, FFP will identify a proposed maximum allowable elevation of in-river infrastructure (turbines, pilings, etc.) that would avoid the potential for any adverse effects on navigation at each FFP Project Site
G. Calculate the estimated range of variation in bed elevation that is typical at representative mounting locations at each site. FFP will also provide a description of steps that would be undertaken if erosion affects the structural stability of turbine mounting infrastructure.
H. Evaluate the seasonal and long-term (past 30 years) variability in the size, quantity, and variety of large (greater than 5 feet in diameter), negatively and neutrally buoyant debris transported by the Mississippi River. This assessment will include a review of existing literature, anecdotal information and observations, and consultation with knowledgeable agency staff and other individuals with expertise in this area. Free Flow Power will consult with the Corps to gather and evaluate available information on the nature and size of large debris transported by the river, including photographic records of accumulated trees, root wads and other large debris that can be observed at low water at some locations.
I. FFP will determine the number, location, and configuration of turbines that have been proposed to deploy at each mounting location (i.e., piling or other mounting structure) at each FFP Project Site, which will conform to the maximum allowable elevation and minimum bottom clearances as established by the study.
J. FFP will establish monitoring and maintenance procedures that will be implemented to ensure that any debris accumulation that extends above the maximum allowable elevation for in-river infrastructure is promptly removed.
K. FFP will indentify the location and extent of any areas within each proposed lead site where the river bottom is currently permitted or used for commercial activities such as commercial dredging, fishing, or fleeting of bottom anchored barges. An estimate of any economic impact on these activities that would be associated with the construction, operation, and maintenance of the proposed project will also be provided.

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

FFP estimates that this study could be performed in 6 months for a budgeted cost of $150,000. Work on this study would begin as soon as soon as the Study Plan Determination is issued by the FERC.

Quarterly progress reports will be provided to the CoE and a draft Study Report will be available for review by the CoE in July 2010. An initial Study Report will be provided to all stakeholders and the FERC via email by September of 2010.

NAVIGATION STUDY

This study is site-specific.

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

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ABSTRACT

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Mississippi River Projects ("TLP Projects"). The ILP and the TLP Projects are collectively referred to as the FFP Projects.

FFP is proposing a study to gather information necessary to develop a plan to deploy hydrokinetic turbines in a manner that will minimize adverse affects on river navigation.

1.1 General Description of FFP's Lead Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

This PSP Document is being submitted in connection with the ILP process for the seven Lead Projects, with the intention that

A. Study design for all studies will be applicable to most or all studies conducted for FFP Projects, and
B. Results for certain studies, which are to be conducted on a limited number of ILP Projects or on a site-independent basis (e.g., in a test tank), will be applicable to all FFP Projects.

The location of each FFP Project by state and river miles is presented below:

ILP Projects

		River Mile	
Project	**State(s)**	**Start**	**End**
Greenville Bend	LA	99.1	102.0
Scotlandville Bend	LA	233.9	236.9
Kempe Bend	LA/MS	381.1	386.5
Ashley Point	MS/AR	679.1	695.5
Hope Field Point	AR/TN	725.0	736.9
Flora Creek Light	MO/IL	51.2	58.0
McKinley Crossing	MO/IL	182.1	184.1

TLP Projects

		River Miler	
Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Fashion Light	LA	121.5	126.5
Thirty Five Mile Point	LA	128.3	130.9
Woodland Light	LA	132.4	136.5
Forty Eight Mile	LA	139.5	146.2
Remy Bend	LA	149.8	152.2
College Point	LA	155.5	157.8
Brilliant Point	LA	160.8	166.4
General Hampton	LA	168.3	174.5
Eighty One Mile Point	LA	175.5	182.0
Claiborne Island	LA	184.2	188.2
White Alder	LA	191.2	196.4
Point Pleasant	LA	197.9	201.0
Reliance Light	LA	205.7	210.8
Manchac Point	LA	213.9	218.4
Duncan Point	LA	219.5	224.0
Sara Bend	LA	262.3	266.2
Morgan Bend Crossing	LA	274.9	283.5
Newton Bend	LA/MS	417.8	427.4
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Cat Island	LA/MS	493.6	500.0
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Malone Field Light	MS/AR	582.1	591.5
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Williams Point	TN/MO	873.0	880.9
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Wickliffe	MO/KY	950.0	952.9
Greenfield Bend	MO/IL	1.0	9.5
Gale Light	MO/IL	43.5	46.8
Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
Arsenault Island	MO/IL	176.5	180.4
Wilson Island	MO/IL	188.5	195.5
Mobile Island	MO/IL	196.4	198.2

1.2 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects – the "Lead Sites" – are being processed under the

FERC's default Integrated Licensing Process. FFP has requested and received waivers to use the Traditional Licensing Process for the remaining 48 Mississippi River Projects.

This PSP is being filed pursuant to FERC regulations issued on July 23, 2003 for the ILP (18 CFR Part 5). Relevant state and federal agencies, Indian tribes, non-governmental organizations, and the general public will participate in the FFP Projects ILP. During the ILP, information needs for the licensing process will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b), which states that any information or study request must:

A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
C. If the requester is not an a resource agency, explain any relevant public interest considerations in regard to the proposed study;
D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of the study is to prepare and analyze a navigation plan for the construction of hydrokinetic projects with minimal adverse effect on river navigation

The specific objectives of the study are to:

- Assess existing river navigation patterns relevant to FFP Projects
- Determine construction and maintenance practices that would minimize impacts to river navigation and risks to public safety

SECTION 3 STUDY AREA

This study will be conducted on navigation patterns at each FFP Project Site.

SECTION 4 BACKGROUND & EXISTING INFORMATION

As a part of the consultation FFP engaged in for the PAD, we committed to working in cooperation with the Corps, the Coast Guard, and other governmental and industrial entities to minimize or avoid any interference to commercial navigation associated with installation or maintenance of its turbine generators. FFP will also determine the navigation restrictions and channel marking measures that may potentially be imposed during the construction and maintenance of proposed project sites, in order to avoid or minimize the risk of navigation incidence.

SECTION 5 PROJECT NEXUS

This study would help in determining whether navigation would need to be restricted during the times when construction or maintenance work is under way, and to minimize interference and costs associated with potential navigation restrictions or delays.

SECTION 6 METHODOLOGY

FFP proposes that this study include the following:

- Information on the seasonal, daily, and hourly navigation patterns for commercial and recreational traffic relevant to each site, seasonal variations in depth requirements associated with changes in the type and weight of cargo that is transported.
- A summary of available information on the nature, amount, and seasonal timing of recreational boating that will occur in or near areas where turbines will be deployed.
- Strategies for the construction and maintenance that will minimize interference with navigation.
- Nature and extent of any navigation restrictions that may be required during construction or maintenance.
- Description of any channel markings necessary during construction or maintenance of turbines.
- An estimate of the economic costs to commercial navigation of any restrictions that would be required.
- Measures for communication and coordination for notification of construction and maintenance activities, including a discussion of entities that will be consulted and timing/schedule for the provision of such information.

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

Free Flow Power estimates that this study would cost between $50,000 and $75,000 and could be completed in approximately 4 to 6 months.

Work on this study could begin immediately after the issuance of the Study Plan Determination. Quarterly Progress Reports will be provided to the CoE and the Coast Guard via email. FFP anticipates being able to provide stakeholders with an Initial Study Report via email in September 2010.

HYDRAULIC STUDY

Portions of this Study are Site-Specific;
Some conclusions will be transferable to other Sites
The Methodology is Applicable to all Sites

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
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August 2009

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FFP is proposing a hydraulic study to assess the potential impact of the deployment of hydrokinetic turbines on flow velocities and sedimentation. Changes in flow velocities and sedimentation could have implications for navigation and dredging, habitat for riverine biota, the integrity of US Army Corps of Engineers structures, and natural riverbank stability, either positive or negative. The results of this study will help identify any such impacts and implications and will inform the effective siting of turbine arrays.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

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TLP Projects

Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Fashion Light	LA	121.5	126.5
Thirty Five Mile Point	LA	128.3	130.9
Woodland Light	LA	132.4	136.5
Forty Eight Mile	LA	139.5	146.2
Remy Bend	LA	149.8	152.2
College Point	LA	155.5	157.8
Brilliant Point	LA	160.8	166.4
General Hampton	LA	168.3	174.5
Eighty One Mile Point	LA	175.5	182.0
Claiborne Island	LA	184.2	188.2
White Alder	LA	191.2	196.4
Point Pleasant	LA	197.9	201.0
Reliance Light	LA	205.7	210.8
Manchac Point	LA	213.9	218.4
Duncan Point	LA	219.5	224.0
Sara Bend	LA	262.3	266.2
Morgan Bend Crossing	LA	274.9	283.5
Newton Bend	LA/MS	417.8	427.4
Milliken Bend	LA/MS	451.9	461.9
Cat Island	LA/MS	493.6	500.0
Anconia Point	MS/AR	530.1	531.8
Walker Bend	MS/AR	532.8	537.4
Malone Field Light	MS/AR	582.1	591.5
Helena Reach	MS/AR	662.4	669.0
Plum Point	AR/TN	776.5	788.9
Bar Field Bend	AR/TN	804.7	814.5
Huffman Light	AR/TN	822.8	826.5
Little Prairie Bend	TN/MO	846.5	851.9
Williams Point	TN/MO	873.0	880.9
New Madrid Bend	MO/KY	883.0	893.0
Hickman Bend	MO/KY	917.9	923.8
Wickliffe	MO/KY	950.0	952.9
Greenfield Bend	MO/IL	1.0	9.5
Gale Light	MO/IL	43.5	46.8
Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
Arsenault Island	MO/IL	176.5	180.4
Wilson Island	MO/IL	188.5	195.5
Mobile Island	MO/IL	196.4	198.2

1.2 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects – the "Lead Sites" – are being processed under the

FERC's default Integrated Licensing Process. FFP has requested and received waivers to use the Traditional Licensing Process for the remaining 48 Mississippi River Projects.

This PSP is being filed pursuant to FERC regulations issued on July 23, 2003 for the ILP (18 CFR Part 5). Relevant state and federal agencies, Indian tribes, non-governmental organizations, and the general public will participate in the FFP Projects ILP. During the ILP, information needs for the licensing process will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b), which states that any information or study request must:

A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
C. If the requester is not an a resource agency, explain any relevant public interst considerations in regard to the proposed study;
D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of this study is to assess the potential impact of the deployment of hydrokinetic turbines on flow velocities and sedimentation. Changes in flow velocities and sedimentation could have implications for navigation and dredging, habitat for riverine biota, the integrity of US Army Corps of Engineers structures, and natural riverbank stability, either positive or negative. The results of this study will help identify any such impacts and implications and will inform the effective siting of turbine arrays.

The specific objectives of the study are to:

- Determine metric for measuring impact on flows and on sedimentation from deployed turbines
- Determine thresholds for impact: effects smaller than determined thresholds will be considered de minimis

- Determine the force or "drag" from a single turbine and small groups of turbines and the effect of the drag on flow energy and behavior.
- Assess the impact of turbine deployment on flow conditions and sedimentation, on a site specific basis
- Evaluate the implications of any determined changes on navigation, including potential for vertical updrafts, CoE structures, natural river bank stability, and aquatic habitat based on threshold criteria established

SECTION 3 STUDY AREA

The area covered by this study will depend on the results of representative modeling runs. Initial CFD modeling will focus on the seven lead sites, which include Greenville Bend (site of FFP Project #8), which is known to be an unstable reach of the Mississippi River. After conducting analysis on these sites, FFP will determine whether the results indicate that, even with conservative estimates, hydrodynamic effects fall into the de minimis category. If so, FFP will not commit to doing any more hydrodynamic modeling as part of the Study Plan.

SECTION 4 BACKGROUND & EXISTING INFORMATION

Placement of turbines and mounting structures in the river channel will extract energy from the river, and may cause local changes in flow patterns and velocities and alter sediment transport, which may scouring or deposition in particular areas, changing channel bathymetry in the process. Evaluating the magnitude of these changes will provide information on their potential effects on the resources described previously, and will help determine whether any measures to reduce or mitigate these effects will be necessary.

Computational fluid dynamics (CFD) is one of the branches of fluid mechanics that uses numerical methods and algorithms to analyze problems that involve fluid flows. CFD modeling is a well-established method to analyze the interaction of liquids (and gases) with surfaces defined by boundary conditions

The mathematical bases of almost all CFD models are the Navier-Stokes equations, which define any single-phase fluid flow. CFD models are used by hydraulic engineers to predict flow and sedimentation patterns. Modern CFD techniques enable the numerical modeling of very complex river flows and sediment transport in river systems, provided that boundary conditions can be properly specified. Bates et al (2006) in Computational Fluid Dynamics note that "CFD simulation of river flows is not only financially cost-effective and very efficient, but it can also provide us with a much deeper insight into the structure of river flows than those that may be provided using experimental/field measurements." We do note that CFD modeling should be used in conjunction with field measurements, which will be used to calibrate the models used. In the absence of field

measurements, there would be significant uncertainly about the accuracy of model representations.

Several of the Study Requests received by FFP requested the use of physical to-scale models. This approach can be useful for modeling certain kinds of flow and sedimentation behavior, but are most useful in the consideration of relatively simple and localized problems, e.g. evaluation of sedimentation changes due to a few pilings in a localized area. Use of a physical to-scale model is not useful in the design of this Study Plan because the scale used in typical physical to-scale models would not allow the study of the impact of turbines, as they would be too small. Expanding the scale of a to-scale model enough to allow robust studies of the impacts of the turbine would be cost prohibitive.

Flow patterns and sedimentation alterations for specific reaches of the river can be studied based on results of CFD modeling.

SECTION 5 PROJECT NEXUS

Project-related activities are likely to have a direct impact on flow and sedimentation patterns. The SmarTurbine™ Generator will extract energy from river flows, which will have a direct impact on flow velocities. The change in velocity may cause alterations in sediment transport along the river. Changes in flow velocities and sedimentation could have implications for navigation and dredging, habitat for riverine biota, the integrity of US Army Corps of Engineers structures, and natural riverbank stability, either positive or negative.

SECTION 6 METHODOLOGY

FFP proposes that the study have three distinct phases: near field studies, far field studies using depth-integrated 2D models, far field studies using 3D models.

The first three steps prior to engaging in the three-phase study will be:

- Literature review of available information and studies about the geomorphology and sedimentary processes in the Mississippi River
- Determine metric for measuring impact on flows and on sedimentation from deployed turbines
- Determine thresholds for impact: effects smaller than determined thresholds will be considered de minimis

Phase I: Near Field Studies

CFD models in high and low flow conditions will be used to determine the drag or force and consequent influence on flow energy and behavior from:

- One turbine
- Two turbines on a piling
- Six turbines on a piling

The results from this phase will be aggregated and used in Phases II and III. A summary of certain CFD near field modeling that has been undertaken and a discussion of its expansion is provided below.

Free Flow Power has employed a Computational Fluid Dynamic (CFD) code for the design and analysis of our 3 meter SmarTurbine^{TM} Generator, which is a 7 bladed hydrokinetic turbine with 5 de-swirl vanes integrated in a shrouded diffuser (i.e. venturi design). The objectives of using the ANSYS CFX viscous 3D CFD code were to determine the following:

- Optimized blade shape along the entire span for high turbine efficiency.
- Blade forces.
- Flow and forces on the system and components.
- Design point values of the above, and some off-design operating loads.

The model was analyzed for steady flow using symmetric boundary conditions on 1/7th blade spacing, which accounts for periodicity in the flow. This approach allows greater accuracy on the blade sections, i.e. more nodes per blade than with a full 7 bladed model). Figure 1 below shows a side view of one section of the mesh used, while Figure 1b shows the full 3D model employing 960,000 nodes.

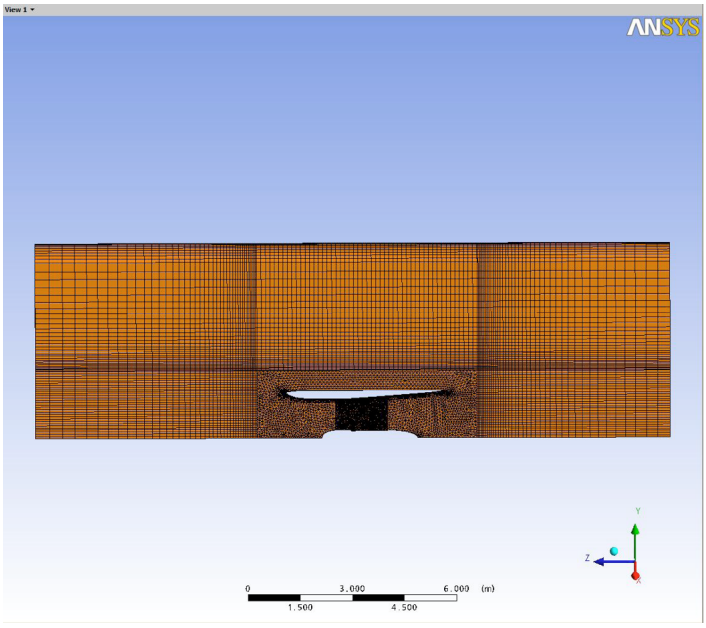

Figure 1a, CFD Mesh Slice

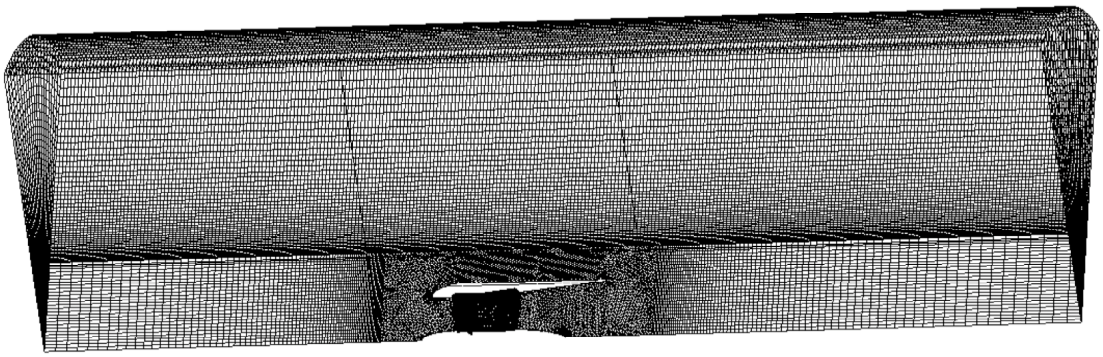

Figure 1b, 3D CFD Mesh

The mesh is also structured in the circumferential direction to fully span the blade details, which, combined with proper boundary conditions being defined, enables the running of CFD analysis. Figure 2, for example, shows a circumferential cut view of velocity contours with stationary reference frame.

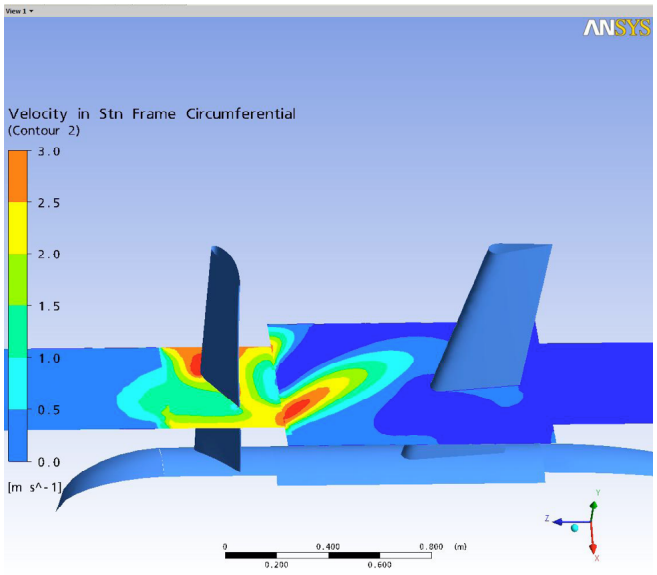

Figure 2, R-Theta cut view of velocity

Figures 3 and 4 show two more options, using the Z plane cut of velocity contours, and the sister results showing the vectors.

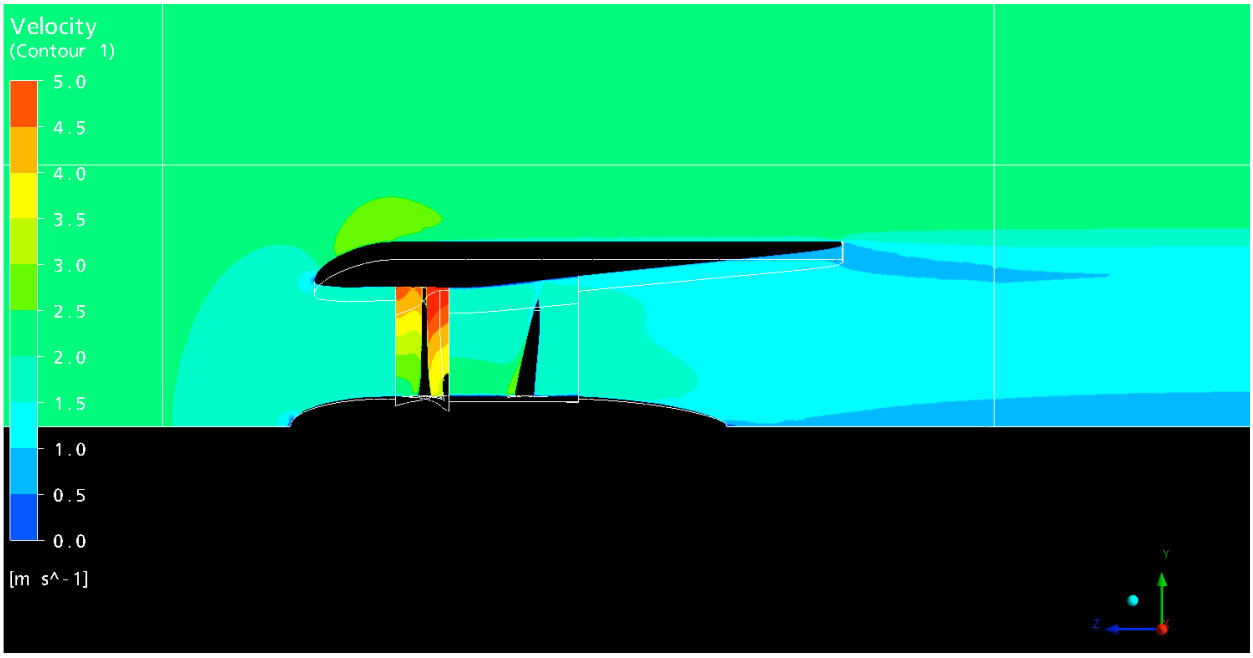

Figure 3, Stationary Frame Velocity Contours

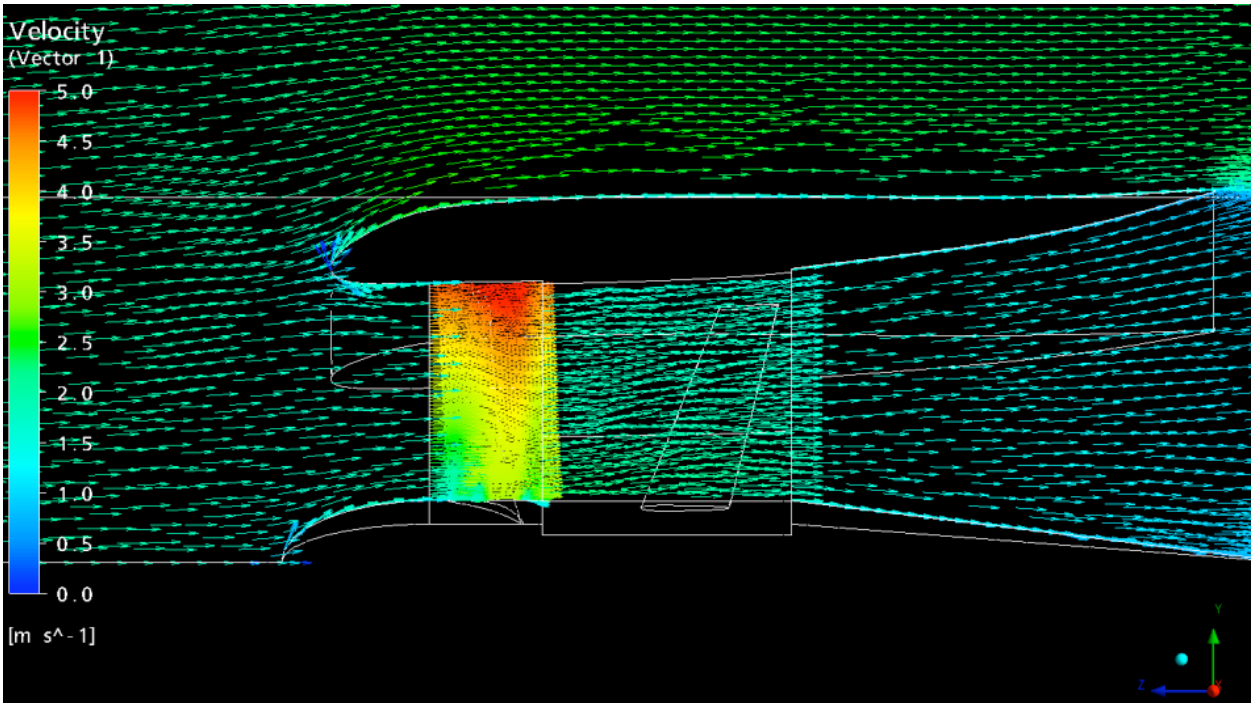

Figure 4, Stationary Frame Velocity Vectors

All loads are calculated from the integrated pressure forces and the calculated fluid drag in the direction desired.

FFP's turbine design uses a constant tip speed ratio so that as stream velocity magnitude changes so does the turbine RPM in the exact same proportionality (i.e. a 2x increase in river speed will also be a 2x increase in RPM). Since Reynolds number effects are minimal from one condition to the next in this design, the constant tip speed means that the flow-field will behave the same with changes in speed, and the scale factors can be used to evaluate any operating condition. A more succinct way to say this is that the Cp, Ct, Cq, Cd, and Lamda are constants, with Cp being the power coefficient, Ct being the thrust coefficient, Cq being the torque coefficient, Cd being the drag coefficient, and Lamda being the constant tip speed ratio.

Therefore, values scale according to:

$$P = Cp*A*0.5*rho*v^3$$

$$T = Cp*A*0.5*rho*v^2$$

$$D = Cd*A*0.5*rho*v^3$$

Where:
P=Power
A=Area (Frontal area of turbine)
Rho-water density
V=velocity
T=Thrust
D=drag

This near field modeling approach can be expanded to account for mounting systems and the arrays of turbines attached to those mounts.

The turbine generator extracts energy from river flows, and this translates to reduced velocity or pressure in the stream along with a rotational component, which is negligible in terms of magnitude. De-swirl vanes removes the majority of the circumferential flow and there is almost no radial component to the turbine flow.

Similarly the velocity vectors show that the radial flow components are small for the housing and diffuser. The housing, nose cone, and tail cone are not designed to be energy removal parts, but the drag created by these does remove flow energy. In fact, a common method of measuring drag is by wake surveys to determine the energy lost from the free steam flow. Therefore, an appropriate modeling methodology is to approximate the downstream flow field. Several modeling alternatives enable this:

- Equivalent drag and frontal area.
- An actuator disk model.

- Various device simplifications such as fan models (negative fan for a turbine) or porous medial models (loss per unit length and cross section).

The actuator disk model, or the negative fan model are the more desirable options since no length component is needed for the mesh, but not all CFD codes employ such options. A flat plate of equivalent drag and frontal area approach is not recommended in this case as there are too many vortices and a less even wake than produced by the SmarTurbine™ Generator. A semi-streamlined approximation is likely the best approach for the following reasons:

- A crude ellipse would have a fairly even wake.
- This type of geometry does not have the Reynolds number sensitivity that a bluff body would.
- An acceptable wake could be developed using the Reynolds number wall algorithms used in many CFD codes.
- Flow directionality that is not normal to the frontal plane of the turbine will be similar to the actual FFP turbine.

The model would seek to create an equivalent body that matches the drag coefficient (Cd) for the given frontal area. A streamlined body such as the ellipse is unlikely to achieve this drag coefficient, so FFP would have to refine the simplification further, possibly with some extreme surface roughness assumptions. Less desirable is to increase diameter since this affects the stream-flow on nearby features (other turbines, pylons, etc.). The combined Cd and frontal area will be evaluated in a separate CFD analysis to approximate the SmarTurbine™ Generator. One note on the combined CFD and frontal area, the earlier statement on frontal area notwithstanding, is that the turbine itself (due to the amount of energy removed) behaves **as-if** it was a larger frontal area than it actually is, with the turbine resistance actually forcing more flow to go around it (as would a larger area).

Phase II: Depth Integrated 2D River Model

The depth integrated (two-dimensional model) will be a numerical cod representing the Shallow Water Equations. The primary assumptions are that pressure is hydrostatic and that the vertical distribution of velocity and concentration is known. The 2D code will also include a bendway correction mechanism important in riverine applications. The 2D river model will include the ability to represent the sediments that make up the bed material of the river in the area of interest. This is typically composed of sands and gravels that behave as noncohesive sediments.

Output from the 2D river model will include the horizontal distribution of depth averaged velocity, water surface elevation, sediment concentration, and changes in bed elevation. This 2D river model will have a domain that extends out from the area of interest a significant distance. The sites for the turbines are generally on the outside of a singled bend in the river. The river is made up of meanders. These are a series of bends in opposite directions separated by crossings. The 2D domain will need to extend upstream

far enough that uncertain boundary conditions do not contaminate the results. This is usually includes the next bend upstream of the area of interest. Flows entering at this crossing have enough distance to relax to their final state before entering the bend containing the turbines. Downstream the model will likely need to extend further to include the equivalent of the next two bends. This will allow the evaluation of the turbine impacts on the overall impact on the general river behavior.

The 2D model will be used to:

1. Create boundary conditions for the 3D river model. This will be the distribution of flow and sediment concentration at the upstream boundary of the 3D river model.
2. Vessel navigation is affected by the water surface slope and drag from the currents. The forces acting on the vessels passing through the navigation channel will be calculated for natural conditions and with turbines present.
3. Horizontal depth-averaged currents, concentration, and bed changes will be calculated over a seasonal time period.
4. Evaluate whether there is any increased level of flood risk and correspondingly, any adverse impact to the authorized level of flood protection provided by the MR&T Project. The 2D model will include long segments of river where changes in water surface elevation can be calculated.
5. Assess impact on natural riverbank stability and on structural integrity of Army Corps structures. Sediment and current results, particularly those that are far away, from the 2D model, can be used to assess impact on natural riverbank stability.

Phase III: 3D River Model

The 3D river model will cover a reach that basically includes the bend containing the area of interest. The model code will represent the Navier Stokes equations. Experiments will determine if the hydrostatic assumption is acceptable. This model will be capable of representing the horizontal and vertical distribution of currents and concentrations. It will use equivalent forces/or objects to produce the far-field impacts of the turbines on currents so that sedimentation behavior can be evaluated. The model will not be used to evaluate currents within a short distance of the turbines.

The 3D river model will be used to:

1. Produce the relationship necessary for the 2D river model to reproduce the appropriate depth average effects of the turbines. These will be modifications of the shear stress relationship.
2. Determine effects on navigation as a result of vertical currents produced by the turbine arrays.
3. Assess sedimentation impacts for a subset of flow conditions.
4. Assess impact on natural riverbank stability and on structural integrity of Army Corps structures. Sediment and current results, particularly those that in the near

vicinity, from the 3D model, can be used to assess impact on natural riverbank stability.

5. Evaluate the effects of large debris collecting on turbine arrays and potential impacts of this on sedimentation patterns.

All models will be validated to reproduce prototype (nature) water surface slope and velocity distribution. The models will also be validated to demonstrate similar sedimentation and morphological patterns.

Testing will consist of base (without turbines) versus plan (with turbines) to reduce uncertainty associated with model error.

Aquatic Life Impacts

The results from each of the three phases of CFD modeling will be used to evaluate impacts on aquatic biota. Specific methodology for this will be:

- An evaluation of the effects of structural elements in the flow path of the Mississippi River on fish distribution and abundance based on literature-review
- Identification of Mississippi River fish and invertebrate species are most at risk of injury or harm as a result of significant flow changes. An initial list provided by the US FWS include the pallid sturgeon (*Scaphirhynchus albus),* shovelnose sturgeon (*Scaphirhynchus platorynchus*), lake sturgeon (*Acipenser fulvescens),* paddlefish (*Polydon spathula*), freshwater drum (*Aplodinotus grunniens*), gizzard shad (*Dorosoma cepedianum*), American eel (*Anguilla rostrata*), striped bass (*Morone saxatilis*), blue sucker (*Cycleputus elongatus*) and goldeneye (*Hiodon slosoides*).
- A history of extensive and intensive studies on conventional power plants indicates that zooplankton and phytoplankton may experience mortality but the primary stressors are thermal elevations and biocide usage, with little effect due to mechanical stressors (Hillman and Morgan 1980, Capuzzo 1980, Karas 1992, Bamber and Seaby 2004).
- Particle tracking methods will be used to define the conditions experienced in both near field and far fields, and exposure histories experienced by different fish species.

SECTION 7 ADMINISTRATION, BUDGET AND SCHEDULE

FFP estimates that this study could be performed in 9 months for a budgeted cost of $250,000. Work on this study would begin as soon as the Study Plan Determination is issued by the FERC.

Quarterly progress reports would be provided in email form to the CoE, FWS, relevant state resource agencies. The progress reports will provide periodic summaries of progress

made in the reporting period, outline the work proposed for the next reporting period, and provide updates on the status of the project and any factors affecting work and schedule.

An Initial Study Report in email format will be provided to the FERC, CoE, FWS, and relevant state resource agencies after completion of work.

SECTION 8 REFERENCES

Allen, Jeffery B., Smith, David C., Eslinger, Owen S., and Valenciano, Miguel A. "A New Approach to Streambed Modeling and Simulation Using CFD." HPCMP Users Group Conference. O (2008): 3-8.

American Society of Civil Engineers. Hydraulic Design of Flood Control Channels. United States of America: ASCE Publications. 1995.

Capuzzo, JM. Impact of power-plant discharges on marine zooplankton – a review of thermal, mechanical and biocidal effects. Helgolander Meeresuntersuchungen 33:422-432. 1980.

Chen, Dong, and Duan, Jennifer G. "Case Study: Two-Dimensional Model Simulation of Channel Migration Processes in West Jordan River, Utah". Journal of Hydraulic Engineering, Vol. 134, No. 3, March 2008, pp. 315-327.

Copeland, R. R., et al, "Entrainment and transport of sediments by towboats in the Upper Mississippi River and Illinois Waterway, numerical model study," Interim report for the Upper Mississippi River-Illinois Waterway System Navigation Study, ENV Report 37. US Army Corps of Engineers. Coastal and Hydraulics Laboratory. Vicksburg, MS. 2001.

Copeland, R. R., Heath, R. E., and Thomas, W. A., "Red River waterway, Lock and Dam number 4, Report 5. Sedimentation in locak approach TABS-2 numerical model investigation," Technical Report. USAE Waterways Experiment Station. 1990.

Fishcer-Antze, Tim (Wald and Corbe Engineering Consultants, Hugelsheim, Germany), Olsen, Nils, Reidar B. and Gutknecht, Dieter. "Three-dimensional CFD modeling of morphological bed changes in the Danube River." Water Resources Research, v 44, n 9. 2008.

Greco, Massimo, Armando Carravetta, and Renata Della Morte. River Flow 2004. London: Taylor & Francis Group plc. 2004.

Hillman, RE and RP Morgan II. The ecological effect of thermal discharges. Pp. 137-150. *In*: L Theodore and AJ Buonicore (eds.), Energy and the environment: Interactions. Vol. I, Part B. CRC Press, Inc., Boca Raton, FL. 1980.

Ingham, D.B. and Ma, L.. "Fundamental Equations for CFD in River Flow Simulations." Computational Fluid Dynamics. Ed. Paul D. Bates, Stuart N. Lane & Robert L. Furguson. Published Online: John Wiley & Sons, Ltd. 2005.

Jia, Y. (Nat. Ctr. Comp. Hydrosci./Eng., Univ. of Mississippi, Carrier Hall 102, University MS 38677, United States) and Kitamura, T.; Wang, S.S.Y. "Simulation of scour process in plunging pool of loose bed-material." Journal of Hydraulic Engineering, v 127, n 3, p 219-229. March 2001.

Julien, Pierre Y. Erosion and Sedimentation. New York: Cambridge University Press, 1994.

Karas, P. Zooplankton entrainment at Swedish nuclear power plants. Marine Pollution Journal 24:27-32. 1992.

Liu, Xiaofeng and García, Marcelo H. "Three-Dimensional numerical model with free water surface and mesh deformation for local sediment scour." Journal of Waterway, Port, Coastal and Ocean Engineering, v 134, n 4, p 203-217. July/August 2008.

Mekonnen, M.A. and Dargahi, B. Source: Proceedings of the International Conference on Fluvial Hydraulics - River Flow 2006, v 2, p 1259-1267, 2006, Proceedings of the International Conference on Fluvial Hydraulics - River Flow 2006. Conference: International Conference on Fluvial Hydraulics - River Flow 2006, September 6, 2006 - September 8, 2006. Publisher: Taylor and Francis/Balkema. 2006.

Mekonnen, Muluneh Admass and Dargahi, Bijan. Source: Proceedings of the Third IASTED International Conference on Environmental Modelling and Simulation, EMS 2007, p 82-87, 2007, Proceedings of the Third IASTED International Conference on Environmental Modelling and Simulation, EMS 2007. Conference: 3rd IASTED International Conference on Environmental Modelling and Simulation, EMS 2007, August 20, 2007 - August 22, 2007 Sponsor: IASTED, Technical Committee on Modelling and Simulation; World Modelling and Simulation Forum (WMSF) Publisher: Acta Press. 2007.

Nagata, Nobuhisa, Hosoda, Takashi, Nakato, Tatsuaki, and Muramoto, Yoshio. "Three-dimensional numerical model for flow and bed deformation around river hydraulic structures." American Society of Civil Engineers. Journal of Hydraulic Engineering, v 131, n 12, p 1074-1087. December 2005.

Nail, Gregory H. and Abraham, David D. "Hydrodynamic and sediment transport study of Sudbury River, Massachusetts : numerical model investigation" U.S. Army Engineer District, New England. US Army Corps of Engineers, Engineer Research and Development Center, Coastal and Hydraulics Laboratory. 2001.

Zeng, Jie, Constantinescu, George, and Weber, Larry. "A 3D non-hydrostatic model to predict flow and sediment transport in loose-bed channel bends". Journal of Hydraulic Research, v 46, n 3, p 356-372. 2008.

FISH ENTRAINMENT STUDY

This study is site-independent

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

August 2009

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ABSTRACT

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Mississippi River Projects ("TLP Projects"). The ILP and the TLP Projects are collectively referred to as the FFP Projects.

FFP is proposing a study to investigate the nature and rate of injury to relevant fish species, or potentially surrogate species for Mississippi River fishes. FFP proposes to first quantify the rotation rate, the rotor blade tip speed, shear stress, pressure changes, turbulence and cavitation associated with the SmarTurbine™ Generator. This would enable evaluation of 1) the potential for fishes to be injured due to passage through or in direct contact with the turbines and 2) the potential cumulative effects of any turbine mortality and injuries on fisheries resources in all relevant Project Sites.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

This PSP Document is being submitted in connection with the ILP process for the seven Lead Projects, with the intention that

A. Study design for all studies will be applicable to most or all studies conducted for FFP Projects, and
B. Results for certain studies, which are to be conducted on a limited number of ILP Projects or on a site-independent basis (e.g., in a test tank), will be applicable to all FFP Projects.

The location of each FFP Project by state and river miles is presented below:

ILP Projects

		River Mile	
Project	**State(s)**	**Start**	**End**
Greenville Bend	LA	99.1	102.0
Scotlandville Bend	LA	233.9	236.9
Kempe Bend	LA/MS	381.1	386.5
Ashley Point	MS/AR	679.1	695.5
Hope Field Point	AR/TN	725.0	736.9
Flora Creek Light	MO/IL	51.2	58.0
McKinley Crossing	MO/IL	182.1	184.1

TLP Projects

Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Fashion Light	LA	121.5	126.5
Thirty Five Mile Point	LA	128.3	130.9
Woodland Light	LA	132.4	136.5
Forty Eight Mile	LA	139.5	146.2
Remy Bend	LA	149.8	152.2
College Point	LA	155.5	157.8
Brilliant Point	LA	160.8	166.4
General Hampton	LA	168.3	174.5
Eighty One Mile Point	LA	175.5	182.0
Claiborne Island	LA	184.2	188.2
White Alder	LA	191.2	196.4
Point Pleasant	LA	197.9	201.0
Reliance Light	LA	205.7	210.8
Manchac Point	LA	213.9	218.4
Duncan Point	LA	219.5	224.0
Sara Bend	LA	262.3	266.2
Morgan Bend Crossing	LA	274.9	283.5
Newton Bend	LA/MS	417.8	427.4
Milliken Bend	LA/MS	451.9	461.9
Cat Island	LA/MS	493.6	500.0
Anconia Point	MS/AR	530.1	531.8
Walker Bend	MS/AR	532.8	537.4
Malone Field Light	MS/AR	582.1	591.5
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Williams Point	TN/MO	873.0	880.9
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Wickliffe	MO/KY	950.0	952.9
Greenfield Bend	MO/IL	1.0	9.5
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1.2 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi

River. Seven of those projects – the "Lead Sites" – are being processed under the FERC's default Integrated Licensing Process. FFP has requested and received waivers to use the Traditional Licensing Process for the remaining 48 Mississippi River Projects.

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A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
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D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of the study is to evaluate the nature, rate and magnitude of fish injury due to passage through or contact with the SmarTurbine™ Generator.

The specific objectives of the study are to:

- Quantify the blade movement (rotation) rate, rotor blade tip speed, shear stress, pressure changes, turbulence, and cavitation and associated with the SmarTurbine™ Generator.
- Determine the size range of fish species that may grow to large sizes in the Mississippi River, and
- Assess probability of these species to strike-related injuries, based on existing data and either a laboratory-based or *in situ* testing program.

SECTION 3 STUDY AREA

This study is site-independent and will be conducted at either a laboratory facility or in connection with a single *in situ* deployed turbine.

SECTION 4 BACKGROUND & EXISTING INFORMATION

FFP's SmarTurbine™ Generator has been designed to minimize adverse impact to aquatic species and includes several specific design features such as a low tip speed ratio, low rpm, a single moving part, and no chemical lubrication. The design process has been significantly improved by industry experience in designing fish friendly turbines. However, there has been no direct testing of injury rates of fish passing through hydrokinetic turbines, such as the SmarTurbine™ Generator.

There have been several experimental approaches to evaluating injuries resulting from propeller blade strikes in the Mississippi River, which have been performed in a test flume environment (Killgore et al. 2001). An approach where fish are injected directly into the turbine in a methodical, observed fashion is scientifically robust for a number of reasons:

- it enables the isolation of factors relevant to the impact of the turbine itself;
- enables the recording of and comparison to control data;
- and, field observation without direct injection would include interpretation of data that would fluctuate for reasons uncorrelated with turbine operation.

In most conventional electrical generation systems, including hydropower, there are major physical stressors present, primarily derived from spinning large turbines and rapid water movement (often pressurized) through a power plant. For hydrokinetic turbines, such as the SmarTurbine™ Generator, mechanical effects from shear, turbulence and pressure changes will be minimal (Coutant and Cada 2005) and far less than in either hydro or steam electric power plants since the generator uses ambient river flows to effect rotor rotation, with little or no effects on riverine organisms (invertebrates) other than potential effects on fish eggs, larvae, juveniles and adults. Fish eggs may experience low morality rates due to their small size and round shape (Morgan et al. 1976).

A history of extensive and intensive studies on conventional power plants indicates that zooplankton and phytoplankton may experience mortality but the primary stressors are thermal elevations and biocide usage, with little effect due to mechanical stressors (Hillman and Morgan 1980, Capuzzo 1980, Karas 1992, Bamber and Seaby 2004).

However, there still remains the question of potential effects on fishes from mechanical strike of the rotor while rotation is occurring. Since hydrokinetic turbines such as the SmarTurbine™ Generator are a new technology using ambient flows, FFP is proposing the direct injection through a prototype generator of fishes that are either present in the Mississippi River or represent fish guild structure. By direct injection, different life stages

can easily be studied and monitored after passage. In addition, repeat injections of the test organisms may be done to determine mortality of multiple passages.

The selection of test fish is also an important consideration. A guild-based approach is a scientifically accepted method. In this case, experimental fishes would be selected that represent potential species of concern or surrogates for each guild.

SECTION 5 PROJECT NEXUS

Fish populations in the Mississippi River may encounter one or more turbines in the Mississippi River and the probability, nature, and magnitude of any injuries they sustain during these encounters can help shape mitigation measures, if needed.

SECTION 6 METHODOLOGY

FFP proposes that this study be conducted according to the following methodology:

- Quantify results for multiple flow variables based on expected water velocities through CFD analyses or test measurements for the following parameters:
  - Rotor rotation rate in Revolutions per Minute (RPM)
  - Rotor blade tip speed
  - Shear stress
  - Pressure changes (defined as pressure changes per distance gradient or with time)
  - Turbulence
  - Cavitation (listed by location and size for any volume that shows a local pressure less than the water vapor pressure)
- Measure scale for each evaluated parameter - for example, a high shear stress that is confined to a very small volume (for example, 0.1 inch) will have little effect on adult fish, thus it is important to understand the scale involved to evaluate the shear stress effects.
- The preferred method is through CFD analysis. For example, cavitation takes place primarily on the moving surface of the blade, which is difficult to measure on a rotating blade. Similarly, high shear areas are often near rotating blade surfaces or leading edges and can be equally difficult to measure.
- Conduct a literature review on fish species that occur in the Mississippi River in the vicinity of these projects, focusing on size, especially large fish, and on known sensitivities to strike-related injuries;
- Conduct a lab-based or *in situ* testing program in which an injection and collection system will be designed and installed in a test flume or at a demonstration deployment site with a SmarTurbine^{TM} Generator;
- Inject test fishes, including adult, juveniles and larval stages, which will be selected as a result of the literature review performed in the previous step (likely

using a guild-based approach), will be directly inserted into a tube, where they will be transported by water flows to the blades of the turbine; and

- Test fishes will be tested at water flows of 1, 2, and 3 meters per second, with a control test consisting of the locked turbine and water velocity of 2 meters per second. If an *in situ* test is performed, the effect of different flow speeds may be captured by doing drag tests. Injected fish will be removed from the tubes, evaluated for injury, and observed over the next 48 hour period for any evidence of delayed injury or mortality. Repeated passages of test species through the test unit may be done to evaluate multiple passages.
- From this testing, FFP will determine the number of adult, juvenile and larval fishes can be expected to experience immediate and delayed mortality on an annual basis and over the life of the proposed license.

SECTION 7 ADMINISTRATION, BUDGET AND SCHEDULE

Free Flow Power estimates that this study would cost between $150,000 and $200,000 and could be completed in approximately 8 months.

Work on this study could begin immediately after the issuance of the Study Plan Determination. Quarterly Progress Reports will be provided to US FWS via email and FFP anticipates being able to provide an Initial Study Report in October 2010.

SECTION 8 REFERENCES

Bamber, RN and RMH Seaby. The effects of power station entrainment passage on three species of marine planktonic crustacean, Acartia tonsa (Copepoda), Crangon crangon (Decapoda) and Homarus gammarus (Decapoda). Marine Environmnetal research 57: 281-294. 2004.

Capuzzo, JM. Impact of power-plant discharges on marine zooplankton – a review of thermal, mechanical and biocidal effects. Helgolander Meeresuntersuchungen 33:422-432. 1980.

Coutant, CC and GF Cada. "What's the future of instream hydro?" Hydro Review 24:42-49. 2005.

Hillman, RE and RP Morgan II. The ecological effect of thermal discharges. Pp. 137-150. *In*: L Theodore and AJ Buonicore (eds.), Energy and the environment: Interactions. Vol. I, Part B. CRC Press, Inc., Boca Raton, FL. 1980.

Karas, P. Zooplankton entrainment at Swedish nuclear power plants. Marine Pollution Journal 24:27-32. 1992

Killgore, KJ, ST Maynord, MD Chan and RP Morgan II. "Evaluation of propeller-induced mortality on early life stages of selected fish species." North America Journal of Fisheries Management 21:947-955. 2001.

Morgan II, RP, RE Ulanowicz, VJ Rasin, Jr., LA Noe and GB Gray. Effects of shear on eggs and larvae of striped bass, *Morone saxatilis*, and white perch, *M. Americana*. Transactions of the American Fisheries Society 105(1): 149-154. 1976.

DAMAGED TURBINE RECOVERY METHODS

This study is site-independent.

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

August 2009

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Free Flow Power Corporation

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ABSTRACT

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Mississippi River Projects ("TLP Projects"). The ILP and the TLP Projects are collectively referred to as the FFP Projects.

FFP is proposing a study to evaluate the strength and breakaway thresholds of the turbine arrays in order to determine the probability of a turbine breaking free from an array and the likelihood that such a breakaway turbine would have an adverse impact on the environment, navigation or other areas of concern to stakeholders, and, if necessary, determine how damaged turbine features would be recovered from the river bottom.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

This PSP Document is being submitted in connection with the ILP process for the seven Lead Projects, with the intention that

A. Study design for all studies will be applicable to most or all studies conducted for FFP Projects, and
B. Results for certain studies, which are to be conducted on a limited number of ILP Projects or on a site-independent basis (e.g., in a test tank), will be applicable to all FFP Projects.

The location of each FFP Project by state and river miles is presented below:

ILP Projects

		River Mile	
Project	**State(s)**	**Start**	**End**
Greenville Bend	LA	99.1	102.0
Scotlandville Bend	LA	233.9	236.9
Kempe Bend	LA/MS	381.1	386.5
Ashley Point	MS/AR	679.1	695.5
Hope Field Point	AR/TN	725.0	736.9
Flora Creek Light	MO/IL	51.2	58.0
McKinley Crossing	MO/IL	182.1	184.1

TLP Projects

Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Fashion Light	LA	121.5	126.5
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Anconia Point	MS/AR	530.1	531.8
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Little Prairie Bend	TN/MO	846.5	851.9
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New Madrid Bend	MO/KY	883.0	893.0
Hickman Bend	MO/KY	917.9	923.8
Wickliffe	MO/KY	950.0	952.9
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Gale Light	MO/IL	43.5	46.8
Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
Arsenault Island	MO/IL	176.5	180.4
Wilson Island	MO/IL	188.5	195.5
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Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of this study is to determine the adverse impact associated with damaged turbine features including abandoned pilings, broken turbine housing or blades, and if necessary, determine how they would be recovered from the river.

SECTION 3 STUDY AREA

This study is site-independent.

SECTION 4 BACKGROUND & EXISTING INFORMATION

FFP has spent considerable effort in determining loads on the turbines using Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) analytical methods. Please see FFP's response to FERC's Additional Information Request #1, which is appended to this PSP for a description of these efforts.

SECTION 5 PROJECT NEXUS

Damage caused by impact from logs, debris, and ice loads may significantly damage the turbine assemblies, including potentially causing portions to break free. Unrecovered, these may adversely impact to equipment used for commercial channel maintenance dredging and other navigation-related uses of the river. The potential for adverse impact as well as ways to recapture broken features, if necessary, will need to be studied.

SECTION 6 METHODOLOGY

FFP proposes the following methodology for the study:

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- Evaluate the strength and breakaway thresholds of the turbine array features when they are struck by suspended log, debris and massive ice chunks discharged from the lock and dams.
- Study the breakaway threshold considering the probable weight and kinetic energy that a water-soaked log, debris, and ice chunks would generate under all anticipated low to high river stage velocities.
- Analyze ways to effectively recapture broken turbine array features, if adverse environmental impact would be caused.
- Develop a contingency plan for turbine, piling, and cable removal if FFP determines a particular river reach isn't generating enough current as anticipated for long-term usage.

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

We estimate that this study could be completed in 6 – 9 months, and would cost approximately $70,000. This study could begin as soon as the FERC issues the Study Plan Determination.

Quarterly Progress Reports will be provided to the CoE via email and an Initial Study Report would be provided to stakeholders via email in October 2010.

ELECTROMAGNETIC FIELD (EMF) STUDY

This study is site-independent.

Mississippi River Projects

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P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

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FFP is proposing a study to assess the magnitude and impact of electromagnetic field generation from the SmarTurbine™ and associated cabling systems, and the extent to which that field propagation is likely to affect aquatic biota and navigation.

To perform this study, FFP will identify the contributions to overall electromagnetic field generation from each of the components of the turbine and cabling system, determine the baseline fields in the absence of our systems and the field effects introduced by our systems, determine if there are any increased levels of significance and then assess these levels with known effects on various species and navigation systems. Metrics and thresholds will be determined such that mitigation plans will be developed for effects exceeding such thresholds.

A technical report summarizing the results of this study will provide information needed to inform licensing decisions related to the effects of electromagnetic field generation.

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D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS AND OBJECTIVES

The goal of this study is to assess the magnitude and impact of electromagnetic field generation from the SmarTurbine™ Generator and associated cabling systems, and the extent to which that field propagation is likely to affect wildlife and navigation systems.

The specific objectives of the study are to:

- Determine electromagnetic fields produced by the SmarTurbine™ system comprising these major subsystems:
  - The generator coils
  - The electronic control system
  - The cables going to shore

- Determine SmarTurbineTM effects that are non-negligible compared to the baseline. Compare these increased fields with levels known to have effects on various species and navigation to determine potential end effects on species and navigation.
- Determine metrics and acceptable thresholds limits for field effects.
- Determine mitigation plans to address SmarTurbineTM field effects that exceed thresholds.

SECTION 3 STUDY AREA

While this study will be based on a selected site in the Mississippi River, the study methodology and results are essentially independent of site choice, and will be applicable to all sites.

SECTION 4 BACKGROUND AND EXISTING INFORMATION

4.1 Definitions of Electrical and Magnetic Fields

EM – electromagnetic (EM) describes any phenomena involving electric and/or magnetic fields including electromagnetic fields (EMF), electromagnetic waves (EM waves), electromagnetic interference (EMI), and electromagnetic compatibility (EMC).

EMF - electromagnetic fields (EMF) comprised of electric and magnetic fields either naturally occurring (e.g. earth's magnetic field) or induced by electrical currents in electric machinery, controls, and transmission cabling.

Induced Field – the induced field is a 'secondary' field produced by a 'primary' AC source field. AC magnetic fields induce a nearby electric field.

4.2 Sources of Electromagnetic Field Propagation

Many sources contribute to the electromagnetic field in a river. Some of these sources have a natural origin, such as:

- The earth's magnetic field
- The earth's ionosphere

Other electromagnetic field sources are manmade, for example:

- Electric power transmission cables
- Telephone and data cables
- Sacrificial corrosion protection systems
- Powered commercial and recreational water craft

FFP's SmarTurbine™ Generator may generate electromagnetic fields from the following sources:

- The generator coils
- The electronic control system
- Underwater cabling

4.3 Description of FFP SmarTurbineTM System

The three components of the FFP's SmarTurbine™ Generator system are:

Generator Coils

The generator coils generate 3-phase AC power at a nominal 60Hz in water flows of 2.25m/s. The frequency of the power output is linearly proportional to the water speed, so at a low water speed of 1.5m/s the output frequency is 40Hz, and at a high water speed of 3.5m/s the output frequency is 93Hz. This frequency range is very similar to the 60Hz fundamental frequency of power distribution and transmission lines that cross the Mississippi River in many locations. Near and far field measurements will be made in this frequency range to determine the contribution to the total electromagnetic field from the generator coils.

Electronic Control System

The electronic control system converts the 3-phase AC power from the generator to DC power that is transmitted from the device to the interconnection cable system. The electronic control system is expected to generate low level emissions related to various components. This includes a medium frequency component from the power electronics in the 10kHz range, and very weak emissions from the microprocessor in the 10MHz + range. These emissions are not expected to extend very far from the SmarTurbine™ Generator, so only near field measurements will be made.

Underwater Cabling

Electromagnetic field generation from underwater cable systems is well understood and can be accurately predicted from manufacturers' specifications and mathematical models. Manufacturers' specifications will be combined with data describing the actual voltages, currents and frequency that will be used in SmarTurbine™ Generator arrays to produce field strength maps of operating SmarTurbineTM Generator arrays. The proposed cable system for SmarTurbine™ Generator arrays will use bipolar direct current (DC) cables having two parallel conductors with opposite current direction. Since there will be only a short distance between the two conductor cables, the electromagnetic field emissions will cancel each other. For coaxial and flat bipolar cables, the electromagnetic field emission at a distance of 1m from a cable is expected to be much lower than the natural geomagnetic field strength in the river.

There is nothing substantially new or different about the SmarTurbine system and subsystems in terms of power levels, electrical frequency, and power conversion system configuration compared to several previously studied and reported aquatic-based electrical power systems including:

- Off-shore windfarm systems
- Underwater powerline transmission systems
- Other hydrokinetic wave, current, and tidal systems

4.4 Description of EMF Physics

Electric current running through electric machinery, controls, and transmission cables produces magnetic fields nearby that rapidly decay with distance from the current source. AC current produces AC magnetic fields, and DC current produces DC magnetic fields. AC magnetic fields furthermore induce a nearby AC electric field that also decays rapidly with distance from the source magnetic field, while DC magnetic fields do not induce any electric fields.

If an electric field is present through a conducting material it produces current through that body (e.g. just like a DC battery or AC 110V outlet wired to a light bulb). Some aquatic life forms are electrically conducting to a sufficient degree and in combination with a known sensitivity to such current so as to produce a known effect when in the presence of increased electric fields.

The AC magnetic fields discussed above that induce AC electric fields form what is called an electromagnetic wave. EM waves are only produced at the same frequency as the current source.

Ship navigation and communication systems use high frequency electromagnetic waves that operate through the water. The EM waves can be distorted by physical obstructions or other EM waves that are in proximity, of sufficient strength, and of a particular type (e.g. frequency spectrum range).

4.5 Scope and Relevance of Existing Literature

There has been extensive research and literature published on the aspects of electromagnetic field propagation in water bodies that may be relevant to effects on aquatic life and navigation.

While some of the literature in this area is focused on other sources of energy generation, such as offshore windmill farms, this electromagnetic source information is directly translatable to the sources expected from FFP Projects. There has been significant research into topics of direct interest to stakeholders in FFP Projects, such as comprehensive surveys of technical and biological factors influencing the interaction between power transmission and living organisms. There are also robust and complete descriptions of field emissions from various cabling systems.

Furthermore the range of species of concern is more narrow in the rivers under consideration than in previous ocean-based studies.

This field of literature points to the limited evidence that fish are influenced by the electromagnetic fields from underwater cabling. Likewise, the literature points to limited evidence that EM fields impact navigation and communication equipment.

SECTION 5 PROJECT NEXUS

Electromagnetic fields from the components of FFP's SmarTurbine^{TM} system could affect aquatic species and/or ship navigation and communication.

SECTION 6 METHODOLOGY

FFP will assess EMF from the baseline aquatic systems of interest and from each of the major subsystems of the SmarTurbine^{TM}. systems The study will determine:

- EM spectrum and amplitude from SmarTurbineTM system
- Known EM spectrum and amplitudes that affect species
- EM spectrum and amplitude of known navigation and communication

The primary methodologies will be:

Literature review

Review of previous studies and report from similar applications (primarily recent hydrokinetic and off-shore wind farm studies). Gather data on ratings of equipment studied, EMF generated, aquatic life and ship effects, and mitigation techniques required if any

Engineering analysis

As required to calculate fields not easily scaled from literature review

The reported data for each source will be:

- E-field (Volts/m), amplitude and frequency at distances or far field
- B-field (Telsa), amplitude and frequency at distances or far field
- Characterization of data as bounded (min/max) and/or typical

The reported data for aquatic life resources will be:

- Known aquatic river species susceptible to EMF effects with specified threshold E-field and B-field amplitude and frequency, relative location with respect to the SmarTurbine systems, and end effects.
- Known ship navigation and communication systems frequency bands and strengths, thresholds of interference, relative location of use of these ship systems with respect to the SmarTurbine systems, and end effects resulting from interference.

The data gathered from the field studies will then be analyzed to determine:

- How the levels electromagnetic compare to other electromagnetic sources in the river
- How the additional sources compare to known effects from previous studies of fish and other organisms
- How the additional sources compare to known effects from previous studies of ship navigation and communication interference
- Whether there are any measureable increased end effects, and what mitigation strategies are therefore warranted.

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

Planning for this study will begin shortly after FERC issues the Study Plan Determination in January 2010. We estimate a total study cost of between $15,000 and $35,000, and total estimated hours of 120 person hours.

Quarterly Progress Reports will be provided to the US FWS, the CoE and the US CG via email. An Initial Study Report will be available in October 2010 and provided via email format to stakeholders.

The technical skills necessary to complete the study are knowledge of appropriate electrical engineering, motor boat operation and safety, ship EMF effects, and biological EMF effects.

SECTION 8 REFERENCES

Barnes, F. and Greenebaum, B., Handbook of Biological Effects of Magnetic Fields, CRC Press, 2007.

Cada, G., et.al., "Potential Impacts of Hydrokinetic and Wave Energy Conversion Technologies on Aquatic Environments", Fisheries Journal, April 2007.

Devine Tarbell & Associates, "Report to EPRI: Instream Tidal Power In North America Environmental And Permitting Issues," EPRI-TP-007-NA, June 2006.

DOE, Report to Congress: Potential Environmental Effects Potential Environmental Effects of Marine and Hydrokinetic Energy Technologies, Webinar, November 25, 2008.

FERC Docket, Makah Bay Offshore Wave Energy Pilot Project (Project 12751-000) Order Issuing Conditioned Original License, December 21, 2007.

Gill, A.B., et. al., COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2 EMF-sensitive fish response to EM emissions from sub-sea electricity cables of the type used by the offshore renewable energy industry, March 2009.

Öhman, Marcus C. Sigray, Peter and Westerberg, Håkan. "Offshore Windmills and the Effects of Electromagnetic Fields on Fish", AMBIO: A Journal of the Human Environment, Article: pp. 630–633

Valberg, Memorandum Addressing Electric and Magnetic Field (EMF) Questions – Cape Wind Energy Project, 2005

World Health Organization, What Are Electromagnetic Fields, http://www.who.int/peh-emf/about/WhatisEMF/en/print.html. 2009.

VEGETATION, WILDLIFE HABITAT, & NOXIOUS WEEDS INVENTORY

This study is site-specific.

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

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ABSTRACT

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Mississippi River Projects ("TLP Projects"). The ILP and the TLP Projects are collectively referred to as the FFP Projects.

FFP is proposing a study to identify and gather necessary information needed to understand wetland, riparian, and other wildlife habitats present in areas subject to disturbance by project-related activities at the seven lead sites.

The results will include maps showing the vegetation cover types within all areas with proposed access roads, onshore cables, and substations, or primary transmission lines of the proposed leading projects, and will help inform project siting decisions and any PME measures, if necessary.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

This PSP Document is being submitted in connection with the ILP process for the seven Lead Projects, with the intention that

A. Study design for all studies will be applicable to most or all studies conducted for FFP Projects, and
B. Results for certain studies, which are to be conducted on a limited number of ILP Projects or on a site-independent basis (e.g., in a test tank), will be applicable to all FFP Projects.

The location of each FFP Project by state and river miles is presented below:

ILP Projects

		River Mile	
Project	**State(s)**	**Start**	**End**
Greenville Bend	LA	99.1	102.0
Scotlandville Bend	LA	233.9	236.9
Kempe Bend	LA/MS	381.1	386.5
Ashley Point	MS/AR	679.1	695.5
Hope Field Point	AR/TN	725.0	736.9
Flora Creek Light	MO/IL	51.2	58.0
McKinley Crossing	MO/IL	182.1	184.1

TLP Projects

Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Fashion Light	LA	121.5	126.5
Thirty Five Mile Point	LA	128.3	130.9
Woodland Light	LA	132.4	136.5
Forty Eight Mile	LA	139.5	146.2
Remy Bend	LA	149.8	152.2
College Point	LA	155.5	157.8
Brilliant Point	LA	160.8	166.4
General Hampton	LA	168.3	174.5
Eighty One Mile Point	LA	175.5	182.0
Claiborne Island	LA	184.2	188.2
White Alder	LA	191.2	196.4
Point Pleasant	LA	197.9	201.0
Reliance Light	LA	205.7	210.8
Manchac Point	LA	213.9	218.4
Duncan Point	LA	219.5	224.0
Sara Bend	LA	262.3	266.2
Morgan Bend Crossing	LA	274.9	283.5
Newton Bend	LA/MS	417.8	427.4
Milliken Bend	LA/MS	451.9	461.9
Cat Island	LA/MS	493.6	500.0
Anconia Point	MS/AR	530.1	531.8
Walker Bend	MS/AR	532.8	537.4
Malone Field Light	MS/AR	582.1	591.5
Helena Reach	MS/AR	662.4	669.0
Plum Point	AR/TN	776.5	788.9
Bar Field Bend	AR/TN	804.7	814.5
Huffman Light	AR/TN	822.8	826.5
Little Prairie Bend	TN/MO	846.5	851.9
Williams Point	TN/MO	873.0	880.9
New Madrid Bend	MO/KY	883.0	893.0
Hickman Bend	MO/KY	917.9	923.8
Wickliffe	MO/KY	950.0	952.9
Greenfield Bend	MO/IL	1.0	9.5
Gale Light	MO/IL	43.5	46.8
Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
Arsenault Island	MO/IL	176.5	180.4
Wilson Island	MO/IL	188.5	195.5
Mobile Island	MO/IL	196.4	198.2

1.2 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River.

Seven of those projects – the "Lead Sites" – are being processed under the FERC's default Integrated Licensing Process. FFP has requested and received waivers to use the Traditional Licensing Process for the remaining 48 Mississippi River Projects.

This PSP is being filed pursuant to FERC regulations issued on July 23, 2003 for the ILP (18 CFR Part 5). Relevant state and federal agencies, Indian tribes, non-governmental organizations, and the general public will participate in the FFP Projects ILP. During the ILP, information needs for the licensing process will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b), which states that any information or study request must:

A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
C. If the requester is not an a resource agency, explain any relevant public interest considerations in regard to the proposed study;
D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of this study is to gather the information necessary to understand wetland, riparian, and other wildlife habitat present in the areas that may be disturbed by project-related activities at the seven lead sites. FFP will consider this information to determine whether the proposed construction of transmission lines, substations, and any necessary access roads would affect shore line vegetation and habitat; and whether there is any unique or important shoreline habitat throughout in the areas that ground disturbance is proposed that should be protected.

Specific objectives are:

- Quantitatively describe and map vegetation cover types and associated wildlife in areas where terrestrial disturbance would occur including the proposed onshore cabling, substations, and primary transmission lines

- Delineate, quantitatively describe, and map all wetlands, bald eagle nests, and wading bird nesting areas that occur within 200 feet of the shoreline at areas where shore facilities are proposed, and the extent of these habitats, if they extend beyond 200 feet
- Map any occurrences of invasive species at the seven lead sites.

The field study will produce a habitat inventory report that includes:

- The results of the field study in the form of maps and descriptions
- An assessment of project effects on shoreline vegetation and wildlife habitat at the project sites
- Recommendations for any necessary plant and wildlife protection measures.

SECTION 3 STUDY AREA

The study will first define an area within each Lead Site where ground disturbance is proposed.

SECTION 4 BACKGROUND & EXISTING INFORMATION

FFP has not completed any formal surveys of wetland vegetation for the areas, which would be used for onshore cables, substations, or primary transmission lines of the proposed projects. The PAD describes land cover classes relating to FFP Project sites on the Mississippi River System, including categories of aquatic habitat, emergent marsh habitat, grassland categories, woody plant classes, a sand-mud class, and categories reflecting cultural development. Wetland resources are mapped using GIS data provided by the Lower Mississippi Conservation Committee and the Federal Emergency Management Agency's floodplain dataset.

The PAD lists common bird, mammal, reptile, and amphibian species in the basin as well as 28 invasive plant, invertebrate, and mammal species that are "most troublesome" in the Mississippi River System. However, delineated wetland acreage, acreages of vegetation types, wildlife habitat availability, and specific size and location of invasive species populations at each of the FFP project sites is currently unknown.

SECTION 5 PROJECT NEXUS

Construction, operation, and maintenance activities that are associated with project-related transmission lines, access roads, and substations have the potential to disturb vegetation and wildlife, and spread noxious weeds in the vicinity of FFP's project sites.

This study would assist in identifying and quantifying wetlands, vegetation, wildlife habitat, and invasive species populations in areas where terrestrial habitats could be

affected by construction, operation, and maintenance of the projects. The study would also determine the potential for project activities to disturb wildlife habitat and spread or introduce noxious weeds within the vicinity of FFP project sites.

This information would provide baseline conditions from which to evaluate project alternatives and/or develop and evaluate specific proposals for protection, mitigation, and enhancement of wetlands and wildlife habitat; and the control of noxious weeds.

SECTION 6 METHODOLOGY

The vegetation mapping would involve 3 phases of work. The first two phases will identify general cover types through photo interpretation and field verification. The third phase will be the production of a cover type map. Using digital orthophotos, general vegetation types could be delineated by heads-up digitizing in Arc View (or similar format).

FFP will collect additional data during the field verification to describe the characteristics of each mapped cover type including: species composition, stand structures, habitat quality, and nesting activity. Information collected will include:

A. Wetland delineations following the Corps 1987 manual;
B. Plant species composition, including the dominant and more prominent associated species in each vegetation layer (tree, shrub, and herbaceous layers);
C. Structured data, including estimates of average heights and aerial cover of each vegetation layer;
D. Predominant land use(s) associated with each cover type;
E. Rare, unique, exotic, invasive, and particularly high quality vegetation/habitat;
F. wildlife sightings; and
G. Following consultation with the agencies regarding timing and geographic scope, documentation and mapping of any bald eagle and wading bird nesting that occurs.

The study report will include maps showing the vegetation cover types within all areas with proposed access roads, onshore cables, substations, or primary transmission lines of FFP's proposed lead projects. GIS shape files attributed with cover type, species composition, stand structure, habitat quality, and nesting activity will also be submitted with the report.

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

We estimate that the vegetation, wetlands, and invasive species surveys and mapping at the seven lead sites will cost approximately $100,000, and could be completed in 8 months.

Work would begin as soon as the Study Plan Determination is issued. Quarterly Progress Reports will be provided to the FERC and to the CoE via email. FFP anticipates being able to provide stakeholders with an Initial Study Report in October 2010 via email.

COMMERCIAL FISHING AND RECREATION STUDY PLAN

This study is site-specific.

Mississippi River Projects

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August 2009

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FFP is proposing a study to evaluate the impact of its proposed hydrokinetic Projects on recreational resources, including use of, access to, and safety concerns about recreational facilities and commercial fishing use.

The results of this study will include an assessment of how any project construction, operation, and maintenance measures would potentially affect recreational opportunities and access and commercial fishing use. These results will also help in the development of potential protection, mitigation, and enhancement (PME) measures.

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FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

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Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
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This PSP is being filed pursuant to FERC regulations issued on July 23, 2003 for the ILP (18 CFR Part 5). Relevant state and federal agencies, Indian tribes, non-governmental organizations, and the general public will participate in the FFP Projects ILP. During the ILP, information needs for the licensing process will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b), which states that any information or study request must:

A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
C. If the requester is not an a resource agency, explain any relevant public interest considerations in regard to the proposed study;
D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of this study is to evaluate impacts, both individual and cumulative, of FFP's hydrokinetic projects on recreational use and access and safety-related issues associated with recreational use in the vicinity of the turbines and shoreline facilities of each of the lead sites.

The specific objectives of the study are to:

A. Define the region of study within each FFP Project Site, as described in Section 3, Study Area.
B. Recreation Facility and Commercial Fishing Inventory
    1. Provide a description of existing, land and water-based, recreational opportunities in the region of study for each site.
    2. Identify commercial fishing interests within the region of study

3. Identify key aesthetic areas or features that enhance the recreation experience in the region of study for each site.
4. Provide maps/figures that denote the locations of the existing recreation facilities and commercial fishing areas in relation to the location of the proposed turbine and on-shore structures in the region of study for each site.

C. Recreation Use and Needs Assessment
1. Collect information on recreational use visitation levels (including active and passive recreation types) and user preferences at existing formal public recreational access sites in the of turbine fields and shore facilities to include general usage patterns and more focused data collection near areas that would be altered or where access may be restricted during project construction, operation, or maintenance.
2. Estimate harvest by species for commercial fishing
3. Identify local and regional population trends and trends in recreation activity in the vicinity of turbine fields and shore facilities through available literature, including statewide or regional recreation planning documents (e.g. State Comprehensive Outdoor Recreation Plans) and forecast future recreational use of the project site areas.
4. Evaluate recreational needs in the project site areas and identify and assess potential impacts on recreational use and access due to project construction, operation, and maintenance.
5. Identify any proposed project facilities that could negatively impact the aesthetic quality and recreational viewing experience in the vicinity of the seven lead sites.

D. Recreation Safety
1. Provide a description of existing recreation safety measures (e.g. channel markers, restricted areas) and issues associated with recreational use by bank fisherman, by recreational boaters in the northern sections of the river (upstream of Baton Rouge), by bank recreationists (if a substation happens to be placed near a recreation site), and by swimmers and fisherman in the shallower northern sections upstream of Baton Rouge.
2. Determine the need for fishing or other recreational use closures, and assess the potential interference with other uses such as recreational and commercial angling during project construction and project operation and maintenance.

SECTION 3 STUDY AREA

The region of study within each Lead Site, which is

- the immediate area of the river above placed turbines, pilings and associated cabling, if a piling-based system is used for deployment; or the area of any surface deployment, if that is the deployment system chosen for a particular site.
- the visual zone of shore facilities, which typically is a quarter mile radius of such facilities or farther if the shore facilities are within the foreground or midground view of a public use recreational area

SECTION 4 BACKGROUND & EXISTING INFORMATION

Hydrokinetic projects are significantly different from conventional hydro projects in their impact on recreational resources. Conventional hydro projects' reservoirs create recreational facilities and opportunities in a way that hydrokinetic projects do not. Recreation use in the vicinity of a hydrokinetic facility is independent of project use. Legitimate concern about adverse effects on existing facilities, either through exclusion for water-based activities or through visual impairment of shore-based facilities will need to be evaluated.

In the PAD, FFP provided a description of recreational facilities within the general vicinity of each of the Project Sites, including the seven lead sites. However, since the actual locations of turbines and shore facilities had not been decided at that time, the list was necessarily general in nature. Also, estimates of recreational use were not provided at that time since the list of recreational facilities was broad.

SECTION 5 PROJECT NEXUS

The placement of the proposed turbines within the Mississippi River will have the potential to affect recreational use and access, recreational visitor safety, and commercial fishing use within various sections of the river where these turbines and associated infrastructure are deployed. These potential effects could occur both during the construction period, and also, during the operation and maintenance of the proposed turbines and in-river infrastructure. Also, proposed shoreline substations and transmission lines will have the potential to affect recreational use and safety of the existing recreation facilities and shoreline areas adjacent to these project facilities.

SECTION 6 METHODOLOGY

FFP proposes the following methodology:

- Develop a Recreation Facility Inventory for facilities in the region of study through research and in consultation with entities with recreational facilities within the visual zone (as defined in Section 3, Study Area) of each shore facility.

  The Inventory will provide for each recreational facility the name, nature, ownership, and distance to proposed shore infrastructure.

  The Inventory will describe and photographically document significant aesthetic places and views in the region of study.

  The Inventory will also detail commercial fishing interests in the region of study through consultation with local anglers/commercial operators.

- Develop a Recreation Use and Needs Assessment. Data to be collected on annual use and type of recreational activities and commercial fishing through interviews with entities providing river and shoreline access within a quarter mile of each shore facility.

  The Assessment will incorporate an analysis of regional population and use trends through projections consistent with projections from state agencies, SCORPs, and regional recreational demand assessments.

- Develop an estimate of impact on commercial fishing activities

- Provide an assessment of safety issues in the Study Report, especially an assessment of how project construction, operation, and maintenance measures would affect recreational opportunities, access and safety, and commercial fishing use.

SECTION 7 BUDGET & SCHEDULE

FFP estimates that this study will cost approximately $175,000. FFP estimates that this study can be completed in 6 months.

Work on this study can begin immediately after the Study Plan Determination is issued by the FERC.

Quarterly Progress Reports will be provided to the NPS, the MDC, the TWRA, the Mississippi Department of Wildlife, Fisheries and Parks, the Illinois DNR, and the MO DNR via email. FFP anticipates being able to distribute an Initial Study Report in August of 2009 via email.

ARCHEOLOGICAL AND HISTORIC RESOURCE INVESTIGATION

This study is site-specific.

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

August 2009

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ABSTRACT

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Mississippi River Projects ("TLP Projects"). The ILP and the TLP Projects are collectively referred to as the FFP Projects.

FFP is proposing a study to identify historic properties with the Area of Potential Effect (APE) for each of its Lead Projects in order to determine the Projects' potential effects on historic properties.

The results of this study will be used to develop protection, mitigation and enhancement (PME) measures for historic properties in the Projects' APE. The PME measures will be incorporated into the Historic Properties Management Plan (HPMP), which will be filed with FERC if any historic property is determined to be adversely affected by the Projects.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

This PSP Document is being submitted in connection with the ILP process for the seven Lead Projects, with the intention that

A. Study design for all studies will be applicable to most or all studies conducted for FFP Projects, and
B. Results for certain studies, which are to be conducted on a limited number of ILP Projects or on a site-independent basis (e.g., in a test tank), will be applicable to all FFP Projects.

The location of each FFP Project by state and river miles is presented below:

ILP Projects

		River Mile	
Project	**State(s)**	**Start**	**End**
Greenville Bend	LA	99.1	102.0
Scotlandville Bend	LA	233.9	236.9
Kempe Bend	LA/MS	381.1	386.5
Ashley Point	MS/AR	679.1	695.5
Hope Field Point	AR/TN	725.0	736.9
Flora Creek Light	MO/IL	51.2	58.0
McKinley Crossing	MO/IL	182.1	184.1

TLP Projects

Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Fashion Light	LA	121.5	126.5
Thirty Five Mile Point	LA	128.3	130.9
Woodland Light	LA	132.4	136.5
Forty Eight Mile	LA	139.5	146.2
Remy Bend	LA	149.8	152.2
College Point	LA	155.5	157.8
Brilliant Point	LA	160.8	166.4
General Hampton	LA	168.3	174.5
Eighty One Mile Point	LA	175.5	182.0
Claiborne Island	LA	184.2	188.2
White Alder	LA	191.2	196.4
Point Pleasant	LA	197.9	201.0
Reliance Light	LA	205.7	210.8
Manchac Point	LA	213.9	218.4
Duncan Point	LA	219.5	224.0
Sara Bend	LA	262.3	266.2
Morgan Bend Crossing	LA	274.9	283.5
Newton Bend	LA/MS	417.8	427.4
Milliken Bend	LA/MS	451.9	461.9
Cat Island	LA/MS	493.6	500.0
Anconia Point	MS/AR	530.1	531.8
Walker Bend	MS/AR	532.8	537.4
Malone Field Light	MS/AR	582.1	591.5
Helena Reach	MS/AR	662.4	669.0
Plum Point	AR/TN	776.5	788.9
Bar Field Bend	AR/TN	804.7	814.5
Huffman Light	AR/TN	822.8	826.5
Little Prairie Bend	TN/MO	846.5	851.9
Williams Point	TN/MO	873.0	880.9
New Madrid Bend	MO/KY	883.0	893.0
Hickman Bend	MO/KY	917.9	923.8
Wickliffe	MO/KY	950.0	952.9
Greenfield Bend	MO/IL	1.0	9.5
Gale Light	MO/IL	43.5	46.8
Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
Arsenault Island	MO/IL	176.5	180.4
Wilson Island	MO/IL	188.5	195.5
Mobile Island	MO/IL	196.4	198.2

1.1 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi

River. Seven of those projects – the "Lead Sites" – are being processed under the FERC's default Integrated Licensing Process. FFP has requested and received waivers to use the Traditional Licensing Process for the remaining 48 Mississippi River Projects.

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E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of this study is to determine the potential effects of project construction and operation on the archeological and historic resources that are included in or eligible for the National Register of Historic Places for each FFP Project.

The specific objectives of the study are to:

- Define the Area of Potential Effects (APE) for each Project
- Identify all known cultural resources within the APE, including location information through available literature
- Locate any known above-ground archeological sites in areas where ground disturbance is proposed

- Locate areas with the potential to contain archeological sites within areas where ground disturbance is proposed
- Assess the National Register eligibility of historic and archeological resources within the APE
- Evaluate the Projects' potential effects on historic properties identified within the APE
- If historic properties are adversely affected by construction or proposed operation of the project or from project-related activities, prepare a draft Historic Properties Management Plan (HPMP) to be filed with the Preliminary License Proposal (PLP) and a final HPMP to be filed with the license application

SECTION 3 STUDY AREA

The study will define the APE for each Project Site. In a conventional hydroelectric project, the APE is defined by the project boundaries created by the reservoir. The APE for FFP's hydrokinetic projects will be defined as areas where ground disturbance is proposed on-shore project lands, and lands and properties outside the Project Site's boundaries where project construction and operation or other project-related activities may cause changes in the character of use of historic properties, where historic properties exist.

SECTION 4 BACKGROUND & EXISTING INFORMATION

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies having the authority to license any undertaking to take into account the effect of the undertaking on historic properties. The licensing process for FFP's Projects is considered a federal undertaking and the NHPA and its implementing regulations are applicable.

The Tennessee State Historic Preservation Office has issued its opinion that none of the proposed Projects would affect National Register-listed or eligible resources within its jurisdiction and has requested no cultural resource studies. The Arkansas SHPO has requested a cultural resource survey for FFP Project #42 (Hope Field Point Project, P-12938).

SECTION 5 PROJECT NEXUS

There are a number of Project related activities that could affect cultural resources: there could be buried historic resources such as shipwrecks in areas that FFP could want to drive pilings or there could be historic properties on the banks of the Mississippi River where FFP Projects could intend to bring cables ashore or site shore-based equipment.

SECTION 6 METHODOLOGY

FFP proposes the following methodology for the study:

- Specify the APE for each Project Site
- Identify historic properties, archeological sites and known shipwrecks within the APE for each Project Site through available literature
- Identify any locations that have the potential to contain archeological resources based on publicly available information and consultation with SHPOs
- Evaluate whether any of the sites could be eligible for the NRHP, including considering whether they may contribute to a larger district
- Evaluate Project effects and if historic properties are adversely affected by construction or proposed operation of the project or project-related activities, prepare a draft HPMP to be filed with the PLP and a final HPMP to be filed with the license application.

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

Based on currently available information, this study is assumed to cost $100,000. This budget includes field time to visit Project Sites, some amount of field survey, and analysis of potential project effects, documentation and reporting. We believe this study could be completed in 9 months.

Work on this study could begin as soon as the FERC issues the Study Plan Determination. Quarterly progress reports will be filed with each SHPO, federally-recognized Indian tribes who have an active interest in the Project(s), and the FERC. An Initial Study Report will be provided to stakeholders in October 2010.

ACOUSTIC ENERGY STUDY PLAN

This study is site-independent.

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

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August 2009

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FFP is proposing a study to assess the magnitude and impact of acoustic energy generation and propagation from the SmarTurbine™ Generator system.

To perform this study, FFP will measure near field energy spectrum and amplitude and far field energy spectrum and amplitude, as appropriate, and conduct a literature survey to determine existing data on sound propagation in rivers and the effects of acoustic energy on fish and other aquatic species.

A technical report summarizing the results of this study will provide information needed to inform licensing decisions related to the effects of acoustic energy generation and propagation.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

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1.2 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River.

Seven of those projects – the "Lead Sites" – are being processed under the FERC's default Integrated Licensing Process. FFP has requested and received waivers to use the Traditional Licensing Process for the remaining 48 Mississippi River Projects.

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G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of this study is to assess the magnitude and impact of acoustic energy generation from the SmarTurbine™ system, and the extent to which that field propagation is likely to affect aquatic biota.

The specific objectives of the study are to:

- Determine the non-negligible acoustic energy produced by the SmarTurbine™ system. Compare these acoustic sources with levels known to have effects on various species to determine potential end effects on species
- Determine metrics and acceptable threshold limits for acoustic effects
- Evaluate potential impact to aquatic biota of the measured acoustic energy levels

SECTION 3 STUDY AREA

While this study will be performed at a test site in the Mississippi River, the study methodology and results are essentially independent of site choice, and will be applicable to all FFP Sites.

SECTION 4 BACKGROUND & EXISTING INFORMATION

4.1 Sources of Acoustic Energy Propagation

Many sources contribute to the ambient acoustic energy in a river. Some of these sources have a natural source, such as:

- Natural river flow forces, including turbulence, sediment transport
- Seismic activity

Other acoustic energy sources originate from manmade sources:

- Construction activity
- Propeller noise from motorized vessels
- Engine and other mechanical noise from motorized vessels
- Blasting

4.2 Description of FFP SmarTurbineTM System

FFP's SmarTurbine^{TM} system, and the generator rotating machinery specifically, may generate acoustic energy from:

- Water flow around the cowl and diffuser: turbulence, shear, vortex shedding
- Rotation of the 7-bladed turbine: turbulence, shear, vortex shedding
- Structural vibration

The study will not isolate the acoustic energy generated by each of these processes.

4.3 Scope and Relevance of Existing Literature

There has been extensive research and literature published on the aspects of acoustic energy propagation in water bodies that may be relevant to effects on marine life.

While some of the literature in this area is focused on marine environments, there has been significant research into topics of direct interest to stakeholders in FFP Projects, such as research into the various sources of anthropogenic noise in oceans and evaluations of potential impacts of that water-transmitted energy on organisms. There has also been research into the magnitude of the effects of powered vessels on the underwater acoustic environment. The data in this research is directly relevant to comparatively

assessing the acoustic energy emitted by the SmarTurbine™ system and by other manmade sources, which is important given that the Mississippi River is a commercial waterway supporting passage of ships.

There have also been research efforts into analyzing the impact of incremental acoustic stimuli on fish, indicating that background sound spectra in a river environment affects the ability of fish to discern added acoustic stimuli. The implication of this research is that the background river noise level should be isolated from the incremental noise of the FFP's SmarTurbine™ Generator in order to ascertain impact on fish.

SECTION 5 PROJECT NEXUS

Acoustic energy from the components of FFP's SmarTurbine™ Generator and associated cabling could affect aquatic species.

SECTION 6 METHODOLOGY

FFP will study the acoustic energy emitted by the FFP's SmarTurbine™ Generator. This study will measure:

- Near field energy spectrum and amplitude
- Far field energy spectrum and amplitude

The study will use high quality commercial hydrophones and signal recording equipment such as those made by Bruel & Kjaer. The hydrophones will be calibrated in the field before data gathering commences using an industry standard calibration source. Signals in frequency range of 1Hz to 10kHz will be recorded.

A mobile hydrophone will record the amplitude and spectrum of acoustic energy at a series of locations around the SmarTurbine™ Generator while it is in operation. Measurements will be taken at various angles and distances from the FFP's SmarTurbine™ Generator, while the position of the measurement will be recorded.

The data gathered from the field studies will then be analyzed to determine:

- The absolute acoustic energy emitted by the SmarTurbine™ Generator
- The relative amount of energy emitted compared to both natural and manmade background acoustic energy sources based on a literature review
- The potential impact of the acoustic energy on aquatic species based on a literature review

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

Once FERC issues the Study Plan Determination, FFP will begin acquiring the necessary field equipment and/or the assistance of consultant services to complete this study. This study is estimated to take approximately 8 months at an estimated budged of $50,000 to $70,000.

The technical skills necessary to complete the study are knowledge of appropriate measurement instrumentation and mechanical engineering, motor boat operation and safety, data acquisition, and analysis and management.

Quarterly Progress Reports will be provided via email to the US FWS. An Initial Study Report is anticipated to be available in October of 2009 and will be provided to stakeholders via email.

SECTION 8 REFERENCES

Arveson & Vendittis, "Radiated noise characteristics of a modern cargo ship", J. Acoust. Soc. Am. Volume 107, Issue 1, pp. 118-129 (January 2000).

Amoser & Ladich, "Are hearing sensitivities of freshwater fish adapted to the ambient noise in their habitats?", The Journal of Experimental Biology 208, 3533-3542.

Cornell Bioacoustics Research Program, "Hydrophone Usage and Deployment Collected Methods and Sources", November 27, 1996.

Cada, G., et.al., "Potential Impacts of Hydrokinetic and Wave Energy Conversion Technologies on Aquatic Environments", Fisheries Journal, April 2007.

Michael Stocker, Fish, Mollusks and other Sea Animals' use of Sound, and the Impact of Anthropogenic Noise in the Marine Acoustic Environment Earth Island Institute 2002.

Miyamoto, McConnel, Anderson, Feist, "Underwater noise generated by Columbia River hydroelectric dams", J. Acoust. Soc. Am. Volume 85, Issue S1, pp. S127-S127 (May 1989).

Vella, G., The Environmental Implications of Offshore Wind Generation, January 2002.

RARE, THREATENED, AND ENDANGERED SPECIES STUDY

This study is site-specific.

Mississippi River Projects

ILP PROJECTS
P-12829, P-12861, P-12921, P-12930, P-12938, P-12915, P-12912

TLP PROJECTS
P-12856, P-12849, P-12862, P-12848, P-12851, P-12833, P-12866,P-12855, P-12853, P-12854, P-12845, P-12864, P-12858, P-12865, P-12857, P-12842,P-12869, P-12863, P-12860, P-12843, P-12844, P-12828, P-12822, P-12817, P-12918,P-12927, P-12924, P-12922, P-12919, P-12928, P-12926, P-12925,P-12929, P-12931, P-12942, P-12937, P-12936, P-12932, P-12934, P-12933, P-12941,P-12940, P-12939, P-12914, P-12917, P-12935, P-12913, P-12916

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ABSTRACT

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River. Seven of those projects (the "Lead Projects" or "ILP Projects") are being processed under the FERC's default Integrated Licensing Process ("ILP"). FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Mississippi River Projects ("TLP Projects"). The ILP and the TLP Projects are collectively referred to as the FFP Projects.

FFP is proposing a study to identify rare, threatened, and endangered species within each of its Projects. This study will evaluate the potential effects of proposed projects on RTE species and on their habitats.

A complete study report will detail the methods and results and include maps, GIS data, assessments of project-related effects on RTE species and their habitats. The results will also include discussions of proposed PME measures.

1.1 General Description of the FFP Projects

FFP is proposing hydrokinetic projects in the Mississippi River at 55 site locations. Of these 55 projects, FFP, in consultation with stakeholders, has selected seven sites ("Lead Projects" or "ILP Projects") that will be processed using the Commission's Integrated Licensing Process. The Lead Sites were selected in consultation with resource agencies and other stakeholders as having characteristics that are representative of most or all of the 55 FFP Project Sites. FFP has requested and received waivers to use the Traditional Licensing Process ("TLP") for the remaining 48 Projects ("TLP Projects").

This PSP Document is being submitted in connection with the ILP process for the seven Lead Projects, with the intention that

A. Study design for all studies will be applicable to most or all studies conducted for FFP Projects, and
B. Results for certain studies, which are to be conducted on a limited number of ILP Projects or on a site-independent basis (e.g., in a test tank), will be applicable to all FFP Projects.

The location of each FFP Project by state and river miles is presented below:

ILP Projects

		River Mile	
Project	**State(s)**	**Start**	**End**
Greenville Bend	LA	99.1	102.0
Scotlandville Bend	LA	233.9	236.9
Kempe Bend	LA/MS	381.1	386.5
Ashley Point	MS/AR	679.1	695.5
Hope Field Point	AR/TN	725.0	736.9
Flora Creek Light	MO/IL	51.2	58.0
McKinley Crossing	MO/IL	182.1	184.1

TLP Projects

Project	**State(s)**	**State**	**End**
Ironton Light	LA	58.5	61.5
Live Oak	LA	67.2	69.0
Twelve Mile Point	LA	75.8	86.1
Algiers Light	LA	92.8	95.0
Gouldsboro Bend	LA	95.6	98.2
Carrollton Bend	LA	103.3	105.2
Avondale Bend	LA	108.0	109.8
Kenner Bend	LA	111.1	115.5
St Rose Bend	LA	117.0	119.8

TLP Projects (continued)

		River Mile	
Project	**State(s)**	**State**	**End**
Fashion Light	LA	121.5	126.5
Thirty Five Mile Point	LA	128.3	130.9
Woodland Light	LA	132.4	136.5
Forty Eight Mile	LA	139.5	146.2
Remy Bend	LA	149.8	152.2
College Point	LA	155.5	157.8
Brilliant Point	LA	160.8	166.4
General Hampton	LA	168.3	174.5
Eighty One Mile Point	LA	175.5	182.0
Claiborne Island	LA	184.2	188.2
White Alder	LA	191.2	196.4
Point Pleasant	LA	197.9	201.0
Reliance Light	LA	205.7	210.8
Manchac Point	LA	213.9	218.4
Duncan Point	LA	219.5	224.0
Sara Bend	LA	262.3	266.2
Morgan Bend Crossing	LA	274.9	283.5
Newton Bend	LA/MS	417.8	427.4
Milliken Bend	LA/MS	451.9	461.9
Cat Island	LA/MS	493.6	500.0
Anconia Point	MS/AR	530.1	531.8
Walker Bend	MS/AR	532.8	537.4
Malone Field Light	MS/AR	582.1	591.5
Helena Reach	MS/AR	662.4	669.0
Plum Point	AR/TN	776.5	788.9
Bar Field Bend	AR/TN	804.7	814.5
Huffman Light	AR/TN	822.8	826.5
Little Prairie Bend	TN/MO	846.5	851.9
Williams Point	TN/MO	873.0	880.9
New Madrid Bend	MO/KY	883.0	893.0
Hickman Bend	MO/KY	917.9	923.8
Wickliffe	MO/KY	950.0	952.9
Greenfield Bend	MO/IL	1.0	9.5
Gale Light	MO/IL	43.5	46.8
Cape Bend	MO/IL	47.9	50.2
Ste. Genevieve Bend	MO/IL	115.6	123.0
Arsenault Island	MO/IL	176.5	180.4
Wilson Island	MO/IL	188.5	195.5
Mobile Island	MO/IL	196.4	198.2

1.2 Licensing Process

Free Flow Power Corporation, on behalf of itself and its subsidiary limited liability companies, is developing license applications for 55 Projects on the Mississippi River.

Seven of those projects – the "Lead Sites" – are being processed under the FERC's default Integrated Licensing Process. FFP has requested and received waivers to use the Traditional Licensing Process for the remaining 48 Mississippi River Projects.

This PSP is being filed pursuant to FERC regulations issued on July 23, 2003 for the ILP (18 CFR Part 5). Relevant state and federal agencies, Indian tribes, non-governmental organizations, and the general public will participate in the FFP Projects ILP. During the ILP, information needs for the licensing process will be identified. All study plans intended to meet these information needs will be prepared in a manner that addresses each of the required seven FERC criteria described in 18 CFR § 5.9(b), which states that any information or study request must:

A. Describe the goals and objectives of each study and the information to be obtained
B. If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
C. If the requester is not an a resource agency, explain any relevant public interest considerations in regard to the proposed study;
D. Describe existing information concerning the subject of the study proposal and the need for additional information
E. Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied
F. Explain how any proposed study methodology is consistent with generally accepted practices in the scientific community or, as appropriate considers relevant tribal values and knowledge. This includes any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration;
G. Describe considerations of the level of effort and cost and why any proposed alternative studies would not be sufficient to meet the stated information needs.

SECTION 2 GOALS & OBJECTIVES

The goal of this study is to document any known occurrences of and habitat availability for rare, threatened, and endangered (RTE) species within and/or near FFP proposed lead sites, and to assess the potential project-related effects on RTE species and their habitats.

The specific objectives of this study include:

- Determine the abundance and distribution of RTE species occurring within and near FFP Project Sites;
- Quantify and describe habitat availability for each RTE species occurring in the vicinity of the lead project sites;
- Assess the effects of project-related activities on RTE species and their habitats; and

- Develop protection, mitigation, and enhancement (PME) measures in consultation with FWS, NMFS, and the appropriate State resource agencies for any RTE species and their habitats found during the study

SECTION 3 STUDY AREA

The study will be the area within each Lead Project Site where turbines, cabling systems or shore-based infrastructure will be deployed.

SECTION 4 BACKGROUND & EXISTING INFORMATION

The PAD includes information on RTE species potentially occurring at each of the seven lead sites. These species include the piping plover (*Charadrius melodus*), brown pelican (*Pelecanus occidentalis*), West Indian manatee (*Trichechus manatus*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), pallid sturgeon (*Scaphirhynchus albus*), Alabama heelsplitter (*Potamilus inflatus*), Interior least tern (*Sternula antillarum athalassos*), fat pocketbook (*Potamilius capax*), Louisiana black bear (*Ursus americanus luteolus*), pondberry (*Lindera melissifolia*)), Bachman's warbler (*Vermivora bachmanii*), turgid blossom (*Epioblasma turgidula*), Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*), Decurrent false aster (*Boltonia decurrens*), Mead's milkweed (*Asclepias meadii*), Easter massasauga (*Sistrurus catenatus*), running buffalo clover (*Trifolium stoloniferum*), Alabama shad (*Alosa alabamae*), specataclecase (*Cumberlandia monodonta*), pink mucket (*Lampsilis abrupta*), scaleshell (*Leptodea leptodon*), sheepnose (*Plethobasus cyphyus*), and Illinois cave amphipod (*Gammarus acherondytes*)

The PAD includes descriptions of each RTE species, their known distributions in the United States, and information on their habitat requirements. Of these species, US FWS in its comments on the PAD dated July 14, 2009, has stated that the Gulf sturgeon, the piping plover, the brown pelican, and the Alabama heelsplitter either do not occur in the vicinity of the proposed projects or would not likely be affected by the projects as described.

SECTION 5 PROJECT NEXUS

Project-related activities, such as the construction, operation, and maintenance of the turbines, transmission lines, access roads, and substations could potentially disturb, harm, or kill RTE species and result in the alteration, degradation, or loss of their habitats.

This study will determine the occurrence of RTE species and their habitats within and near the lead sites. The results of this study will serve as baseline information for comparing alternatives, determining project-related effects, and assessing PME measures.

SECTION 6 METHODOLOGY

FFP will:

- Identify potentially occurring habitat for RTE species, from data obtained from FWS, the CoE and ERDC, NMFS, Arkansas Game and Fish Commission, Illinois Department of Natural Resources, Kentucky Department of Fish and Wildlife Resources, Louisiana Department of Wildlife and Fisheries, Mississippi Game and Fish Commission, Missouri Department of Conservation, and the Tennessee Wildlife Resources Agency, and other available GIS data from natural heritage programs or state GIS data libraries.
- Consult with these same agencies after completion of the study in order to review the study findings.
- Put together a complete report that will detail the methods, results and will include maps, GIS data, assessments of project-related effects on RTE species and their habitats, as well as discussion of proposed PME measures.
- Proposed PME measures for the RTE species and their habitats will be included in the license application.

SECTION 7 ADMINISTRATION, BUDGET & SCHEDULE

FFP estimates that this study will take approximately 9 months for an anticipated budgeted cost of between $60,000 and $80,000.

Work on this study request has already begun in terms of consultation with several of the named stakeholders. Quarterly Progress Reports will be provided via email to the FWS, the CoE, and each of the named resource agencies above. FFP anticipates being able to provide an Initial Study Report in October of 2009 via email format to all stakeholders.