



Run-of-River Hydrokinetic Renewable Energy

CLEAN, DOMESTIC, SCALABLE,
CONTINUOUS, COMPETITIVE POWER

April 12, 2010



A new generation of energy

Hydropower
Development

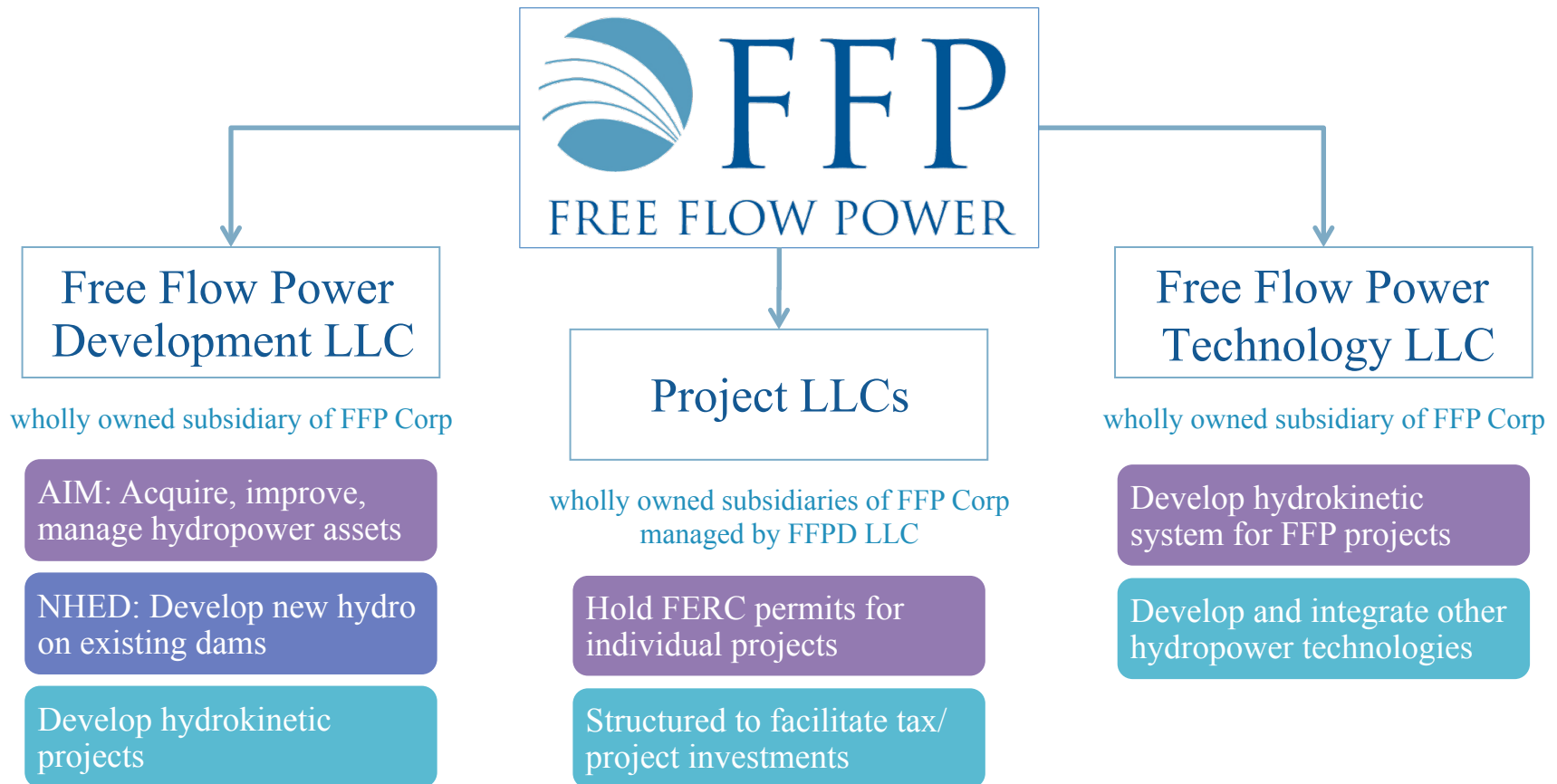
Hydropower
Technology

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Overview of Free Flow Power

- Free Flow Power (FFP) is acquiring and developing hydropower and hydrokinetic facilities to generate clean renewable energy from water.
- Value proposition:
 - **For Investors:** a pure play in hydropower, a valuable yet overlooked renewable energy sector with growth opportunity.
 - **For Electricity Consumers:** carbon-free electricity with greater reliability and a lower cost of power than other renewables.
 - **For Project Owners:** an integrated approach to licensing, engineering, and finance to capture value and address challenges quickly and cost-effectively.

Free Flow Power Corporation



FFP Strengths and Achievements

Project Development

- Industry-leading management, hydro, and finance team (ex-Brookfield Power, UBS Financial, and Army Corps leadership)
- Executing project development plan in conventional hydropower (including Army Corps dams) and hydrokinetics (approx. 100 sites in Mississippi River Basin)

Government Relations

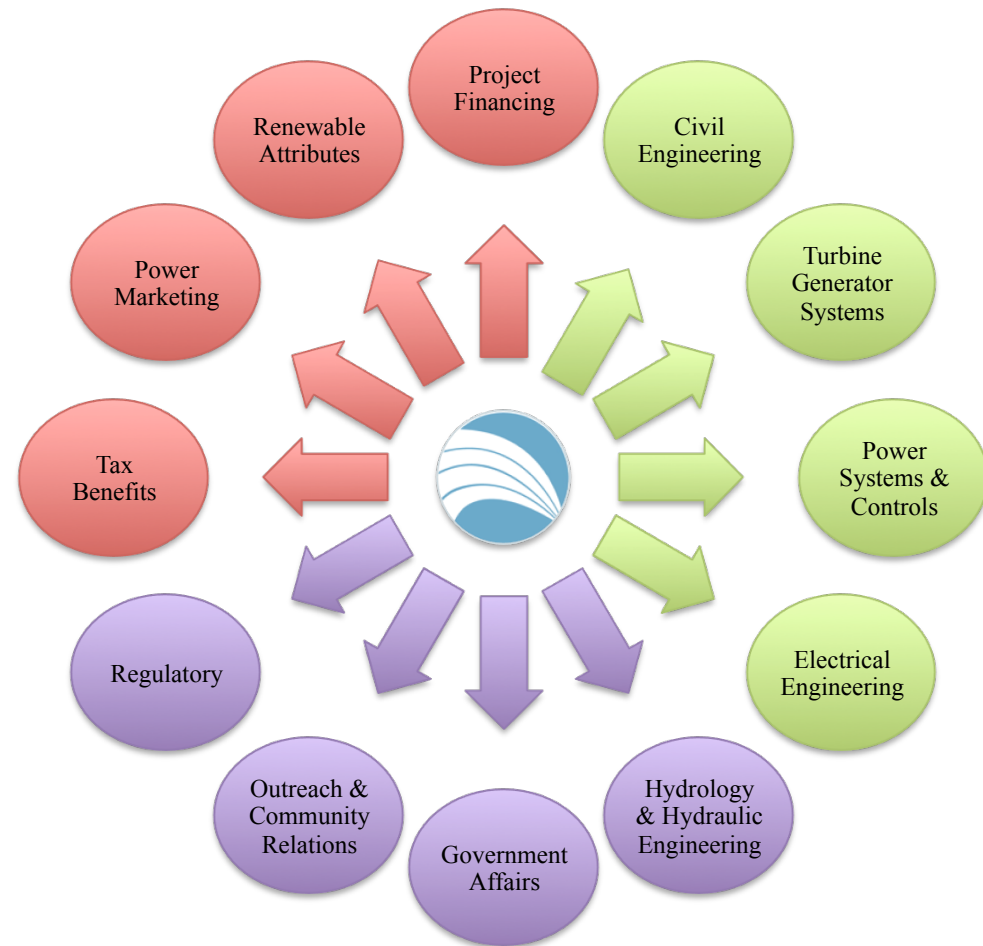
- Completed PAD and Study Plan negotiations in commercial licensing of hydrokinetic sites
- Experience with FERC, Army Corps, and state regulatory environments
- Good resource agency cooperation

Product Technology

- Strong technology team background (MIT, composites, turbines, bearings, electric power conversion)
- \$1.4M DOE grant funding
- Demonstrated subscale SmarTurbine™, full-scale in development

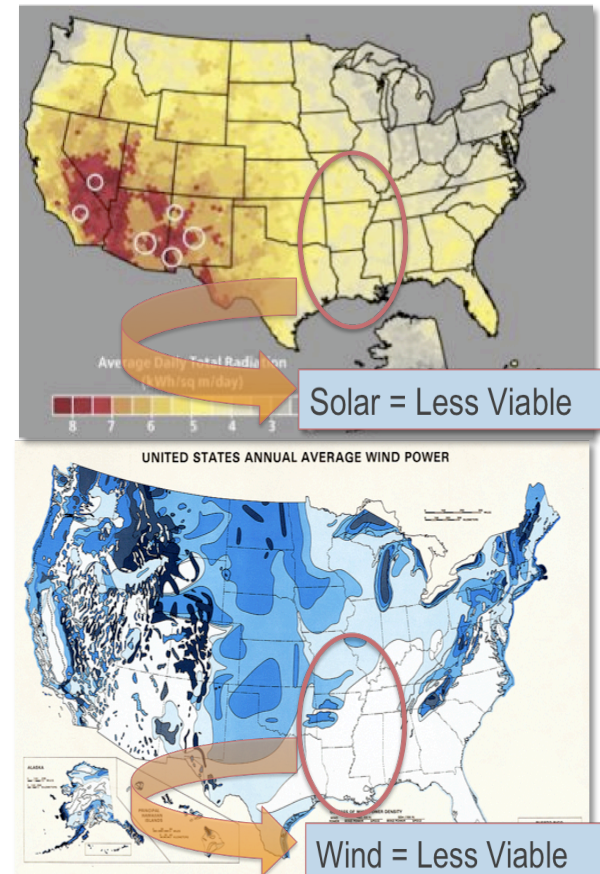
Free Flow Power's Expertise

- Professionals with 35+ years experience developing and managing hydro projects
- Offices in
 - Northeast (Gloucester, MA and Syracuse, NY)
 - Northwest (Bellingham, WA)
 - South (New Orleans, LA)
- Expertise in
 - Financing
 - Engineering
 - Regulatory Affairs



Hydrokinetics in Rivers

- Deploy hydrokinetic generators in Mississippi River Basin with FERC and Army Corps licenses
 - 80 sites on Mississippi River (2 permits pending)
 - 17 sites on Atchafalaya River (permits pending)
- Capacity for 1,000+ MW
- Projects meet regional demand for renewable energy



FFP Timeline

2007

- FFP Founded
- 59 FERC applications filed

2009

- 1-Meter River Deployment
- FERC Study Plan filed
- Conventional hydro business launched
- DOE \$1.4M grant announced

3-Meter Turbine:
40kW in 3 m/s flow



2008

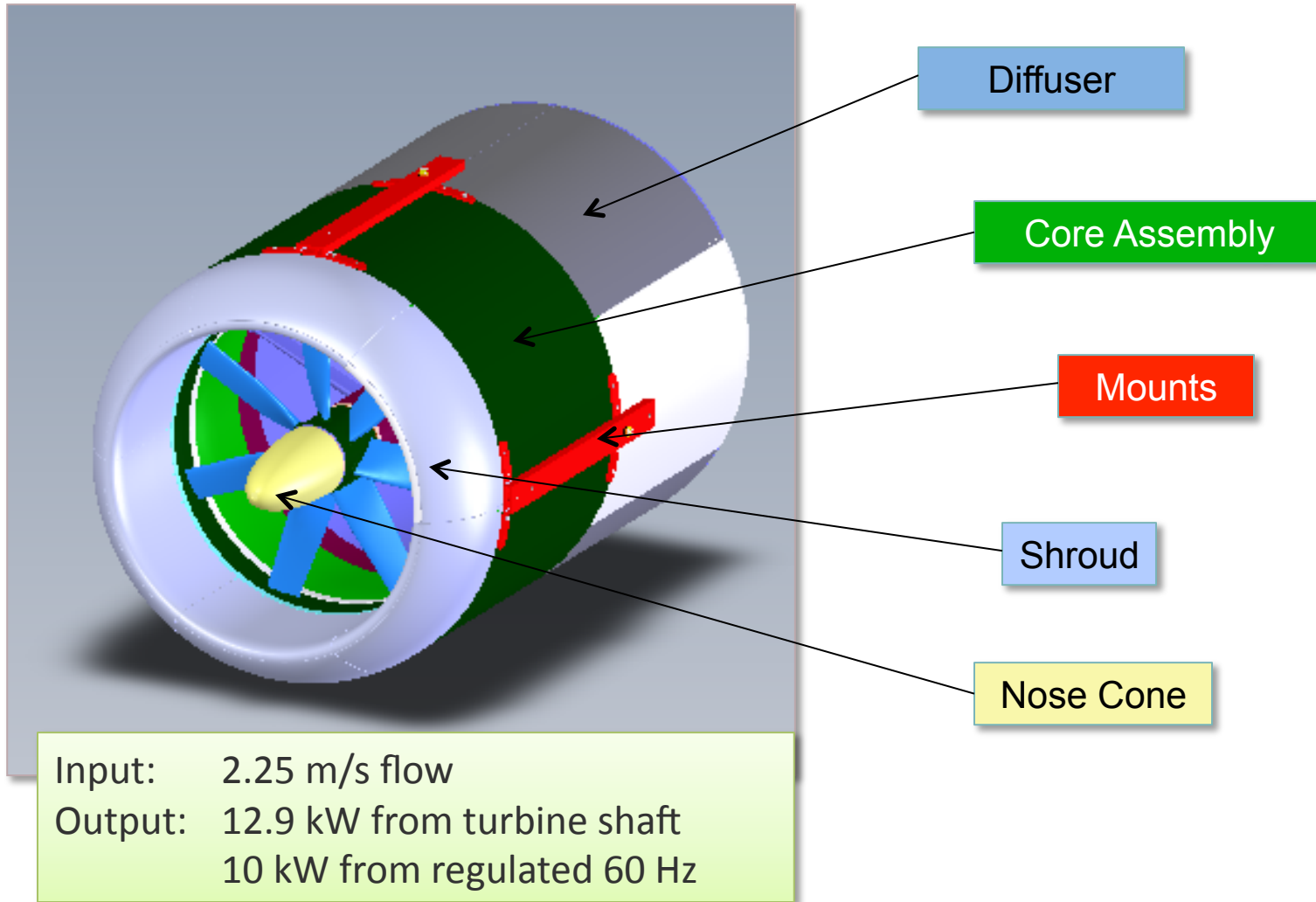
- 1-Meter Flume Tests
- FERC preliminary permits granted

Proof of Concept 1-Meter Turbine:
10kW in 3 m/s flow

2010

- 3-Meter Flume Tests
- FERC Study Plan issued
- More to come...

SmarTurbine™ Generator Components



Designed for Environment

Environment's impact on SmarTurbine™

- Polyethylene forward shroud absorbs impact from large debris.
- Solid epoxy glass blades with strength to withstand medium debris.
- One moving part with rim generator to avoid fouling from small debris.
- Bearing system designed for wear from silt and sand.
- Surfaces treated for bio-fouling.

SmarTurbine's™ impact on environment

- Low tip speed ratio (2:1, compared to 5:1 for wind turbines) to eliminate fish injury from blade strike.
- No high velocity regions to cause turbulent shear stress.
- No small gaps to cause grinding injury.
- Low pressure gradient.
- Deployed below navigation channel, off the riverbed.
- Minimal onshore equipment.
- No chemical lubricants.



Assembled Full-Scale Prototype



- Overall dimensions
 - 3 meter diameter
 - 4.5 meter length
- Rotor
 - 7 blades
 - 2.25 meter diameter
- Weight Goal
 - Wet <3,000 lbs

Other Turbine Design Items

- Solidity: 38% axial view blockage ratio
- Angular velocity
 - Tip speed ratio is 2:1
 - Blade is twisted, but tip angle is ~30 deg
- Fish friendliness
 - De-minimus cavitation areas
 - Low pressure drop
 - Grinding eliminated by solid, recessed rotor rim
 - Low tip speed ratio
- EMF and Acoustics: To be studied under FERC Study Plan
 - Energy per turbine the order of small outboard motor
 - Metal shields magnetic fields, decays at $1/R^2$ to $1/R^3$
 - Cabling plan is DC; limited EM wave propagation
 - Spacing set wide enough to limit superposition
 - Fish primarily respond to higher frequencies and abrupt changes
- Anti-corrosion and anti-biofouling
 - Rich history in offshore & marine industries including environmentally friendly products
 - Evaluating several options during initial deployments
- Standard deployment mid-water column
 - Avoid surface debris and riverbed sedimentation flows

Shakedown Operational Tests



Installed in Test Flume



Initial Running Tests

Ran turbine up to equivalent 3m/s river flow

Benefits of Hydrokinetic Energy

Low Visual Impact

Before:



After:



FFP Project 42, Memphis, TN



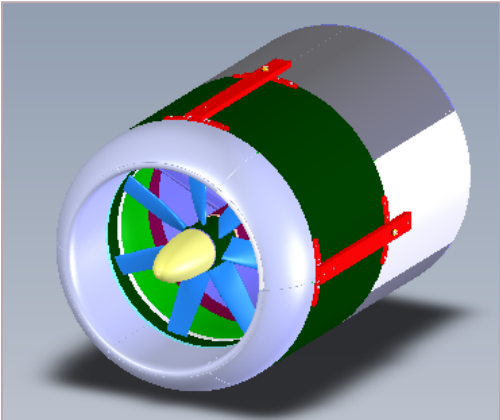
Wind Farm, Palm Springs, CA



Solar Farm, Las Vegas, NV

Reduce GHG Emissions

Avoided Hydrocarbon	Annually, Per SmarTurbine™
CO2 (Tons)	60
Coal (Tons)	36
Oil (Barrels)	130
Natural Gas (Cu. Ft.)	745,540

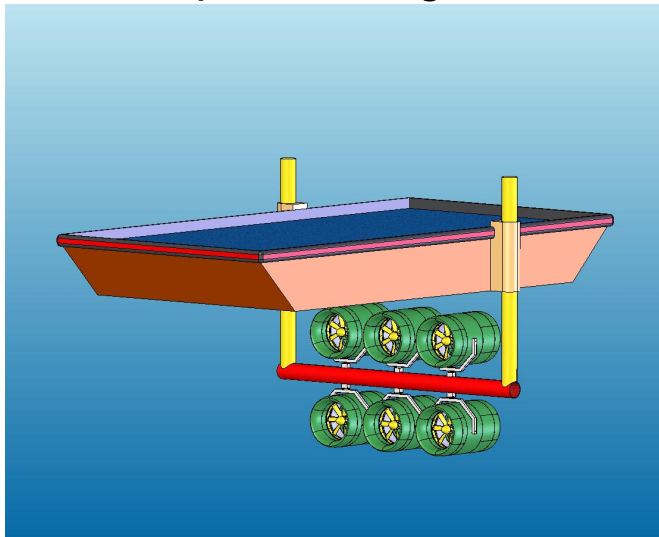


Hydrokinetic Generation



Underwater turbines gather energy from free flowing water without dams or diversions

Example Floating Mount

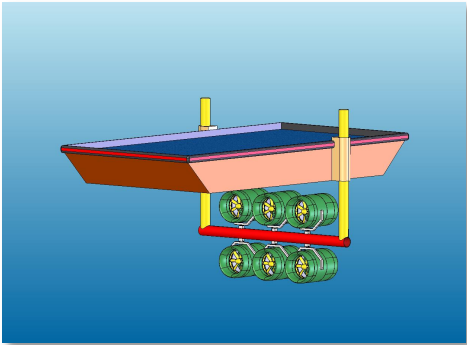


Example Piling Mount



Flexible, Scalable Deployment

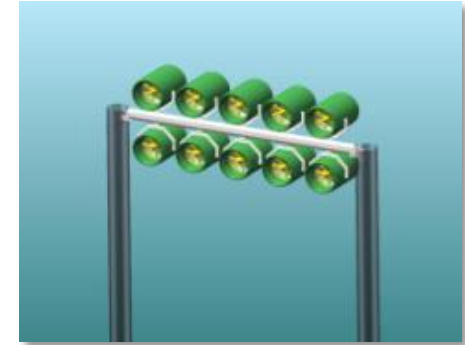
...suspended from the surface



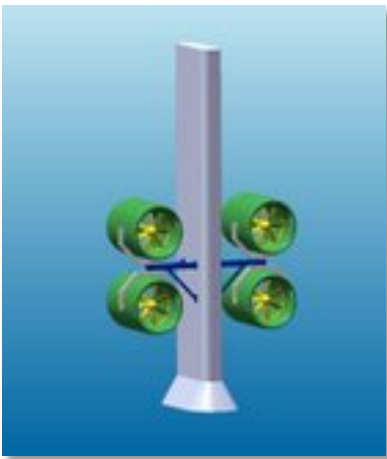
Smarturbines™ can be...



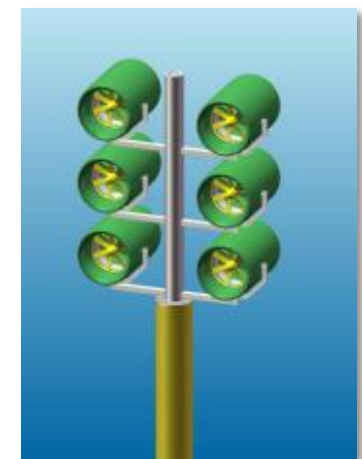
...suspended between pylons



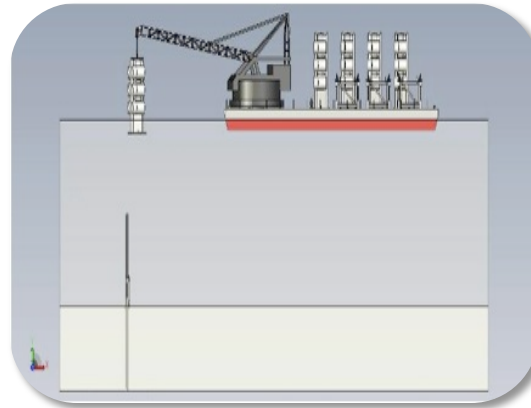
...attached to bridge abutments



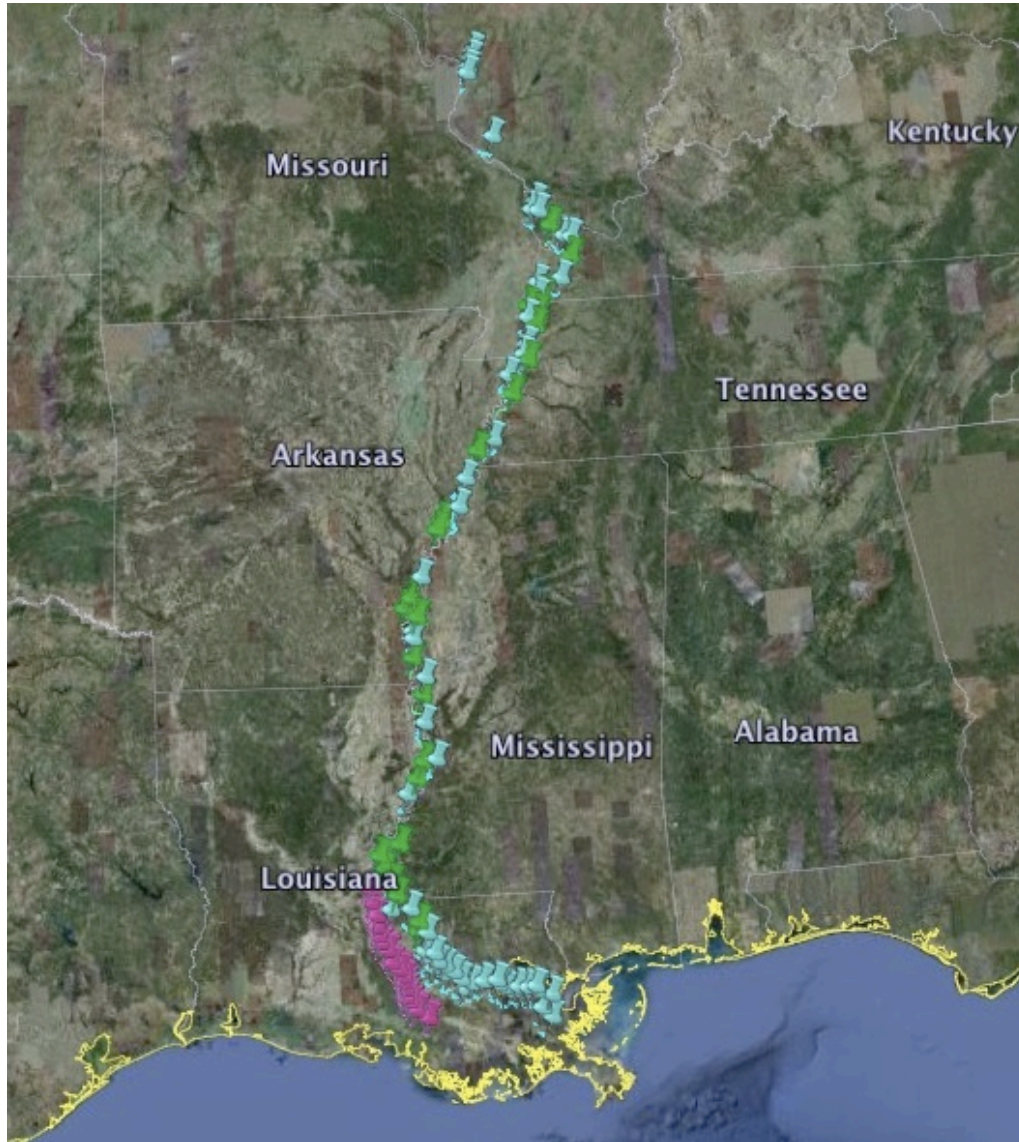
...attached to a pylon



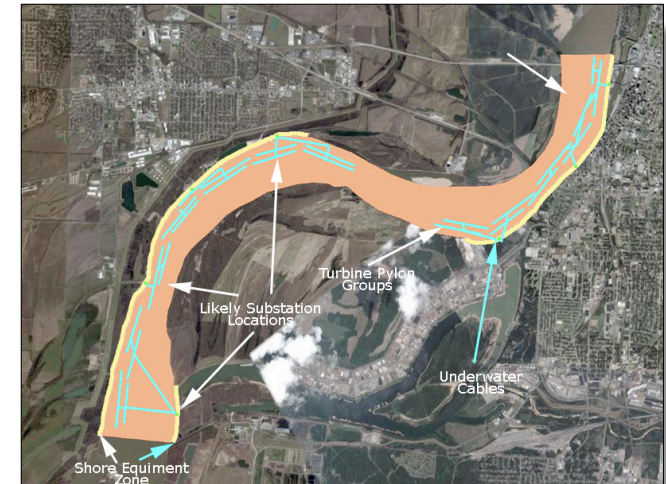
...maintained from barges



FFP's Hydrokinetic Sites



80 FERC permits on Hydrokinetic Sites in Mississippi River (2 pending)



Proposed Installation at FFP Project 42, Hope Field Bend, Memphis, TN

17 Pending FERC Permits on Atchafalaya River

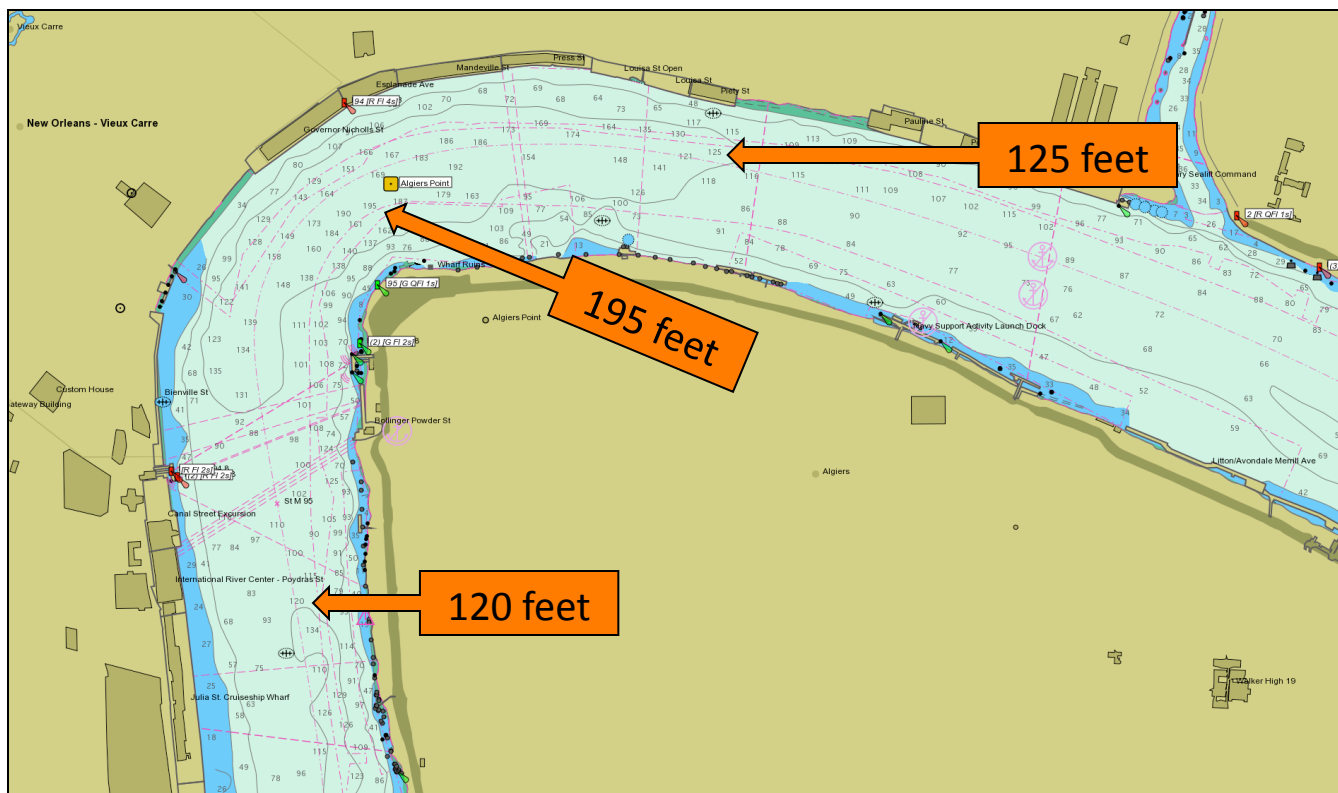
Site Detail – Depth Profile

South of Baton Rouge

- Navigation channel authorized to 55' for shipping traffic
- River depths up to 100'-250'

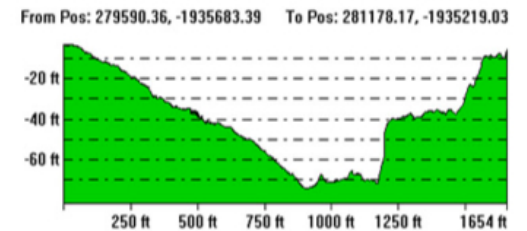
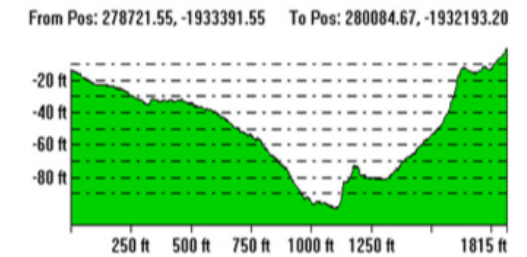
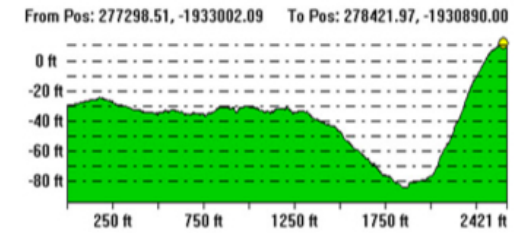
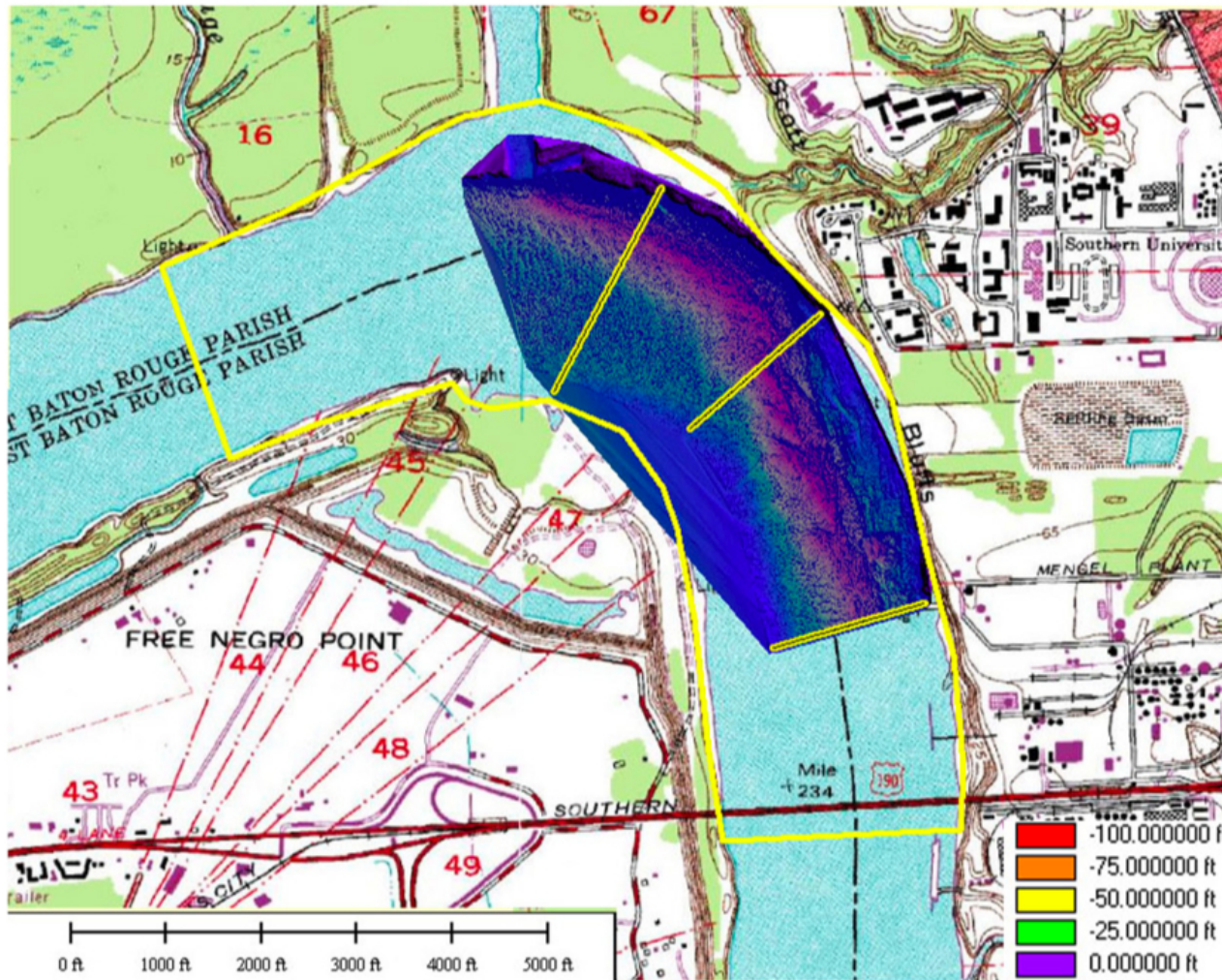
North of Baton Rouge

- Navigation channel authorized to 9' for barge traffic
- River depths up to 30'-50'



FFP Project 6, Algiers Point, New Orleans, LA

Site Detail – Bathymetry



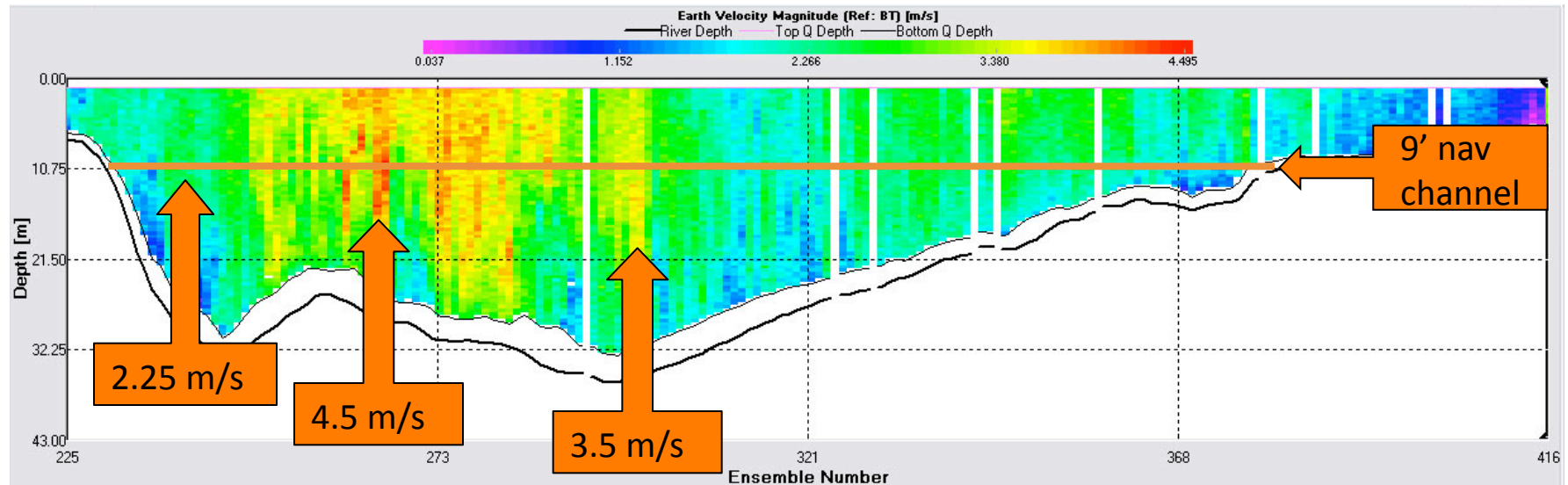
FFP Project 28, Scotlandville Bend, Baton Rouge, LA

Site Detail – Velocity Profile

Target flow = 2.25 m/s, 75% of time

Flows accelerate around outside of bends

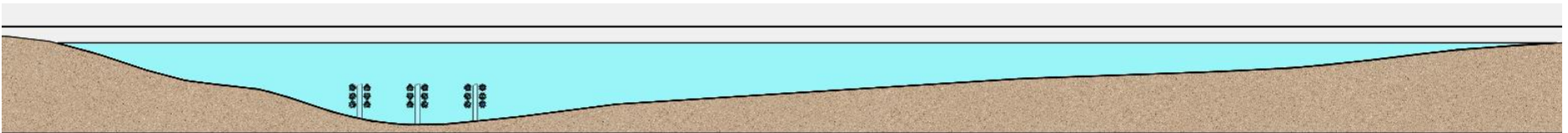
Deeper, no dredging in areas of fast flow



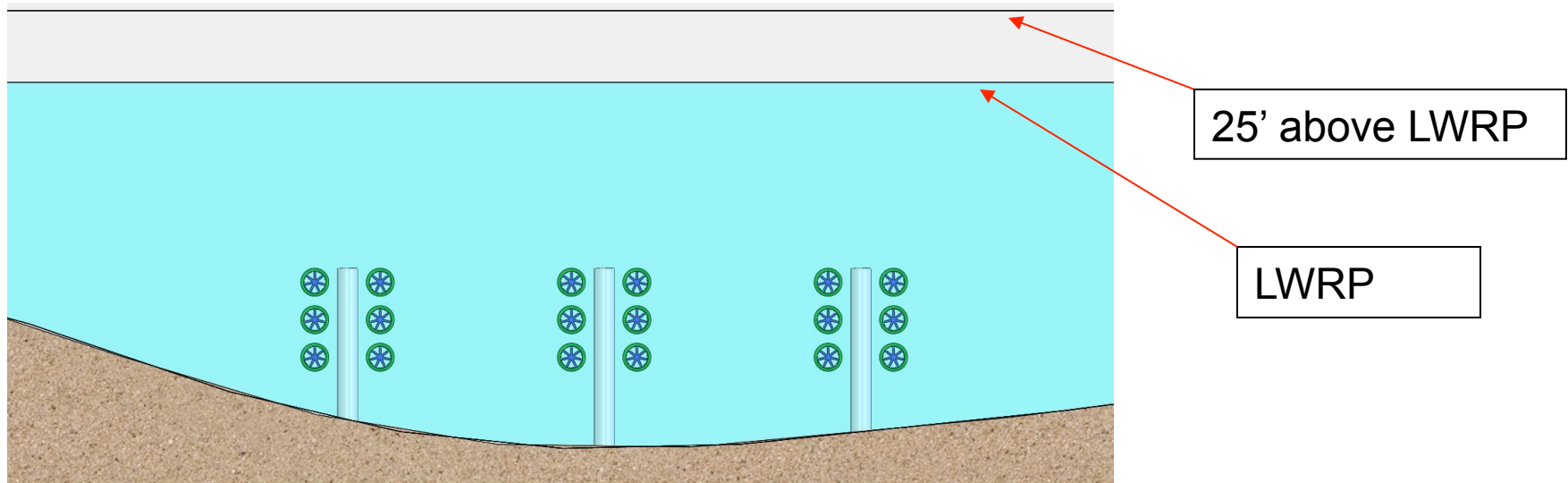
Site near Vicksburg, MS

Scale of Turbine Deployment

- Cross Section, Site 8
 - 2485' Wide at LWRP



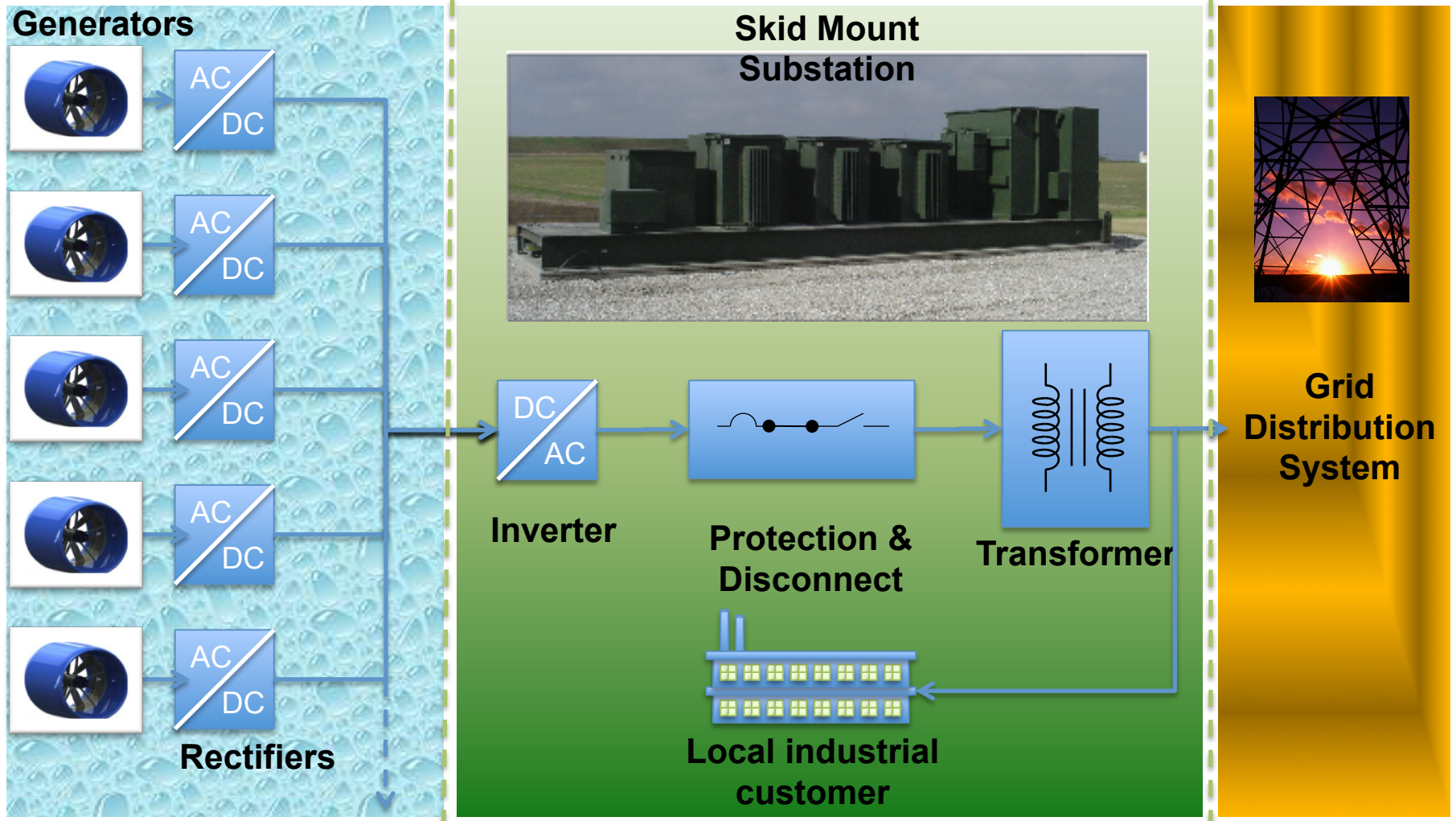
- Zoom of turbines
 - 65' below LWRP



Hydrokinetic Farm Power Distribution System

In The River:

On The Shoreline:



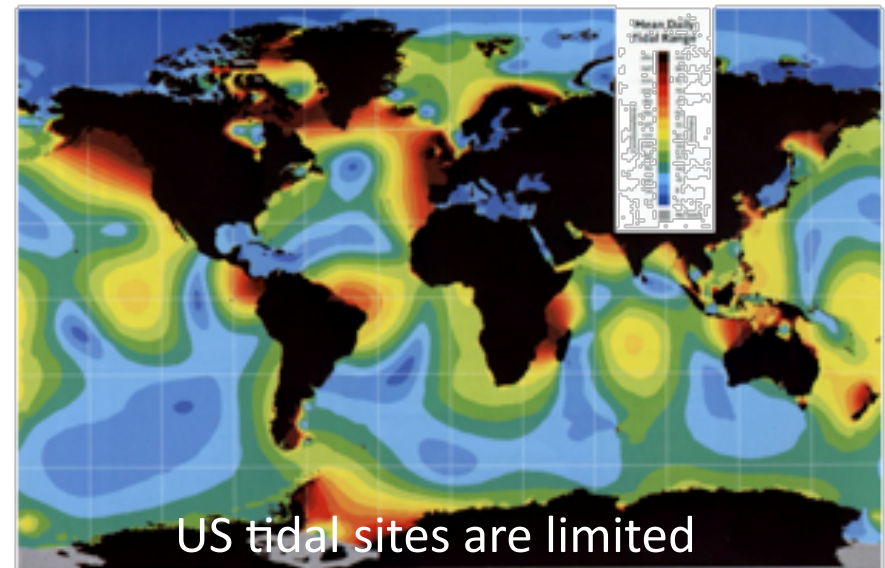
Other Deployment Opportunities

- Existing dams (fore bay inlets, tail races, canals)
- Freshwater and wastewater conduits
- Cooling water returns
- Irrigation canals
- Ocean tides and currents



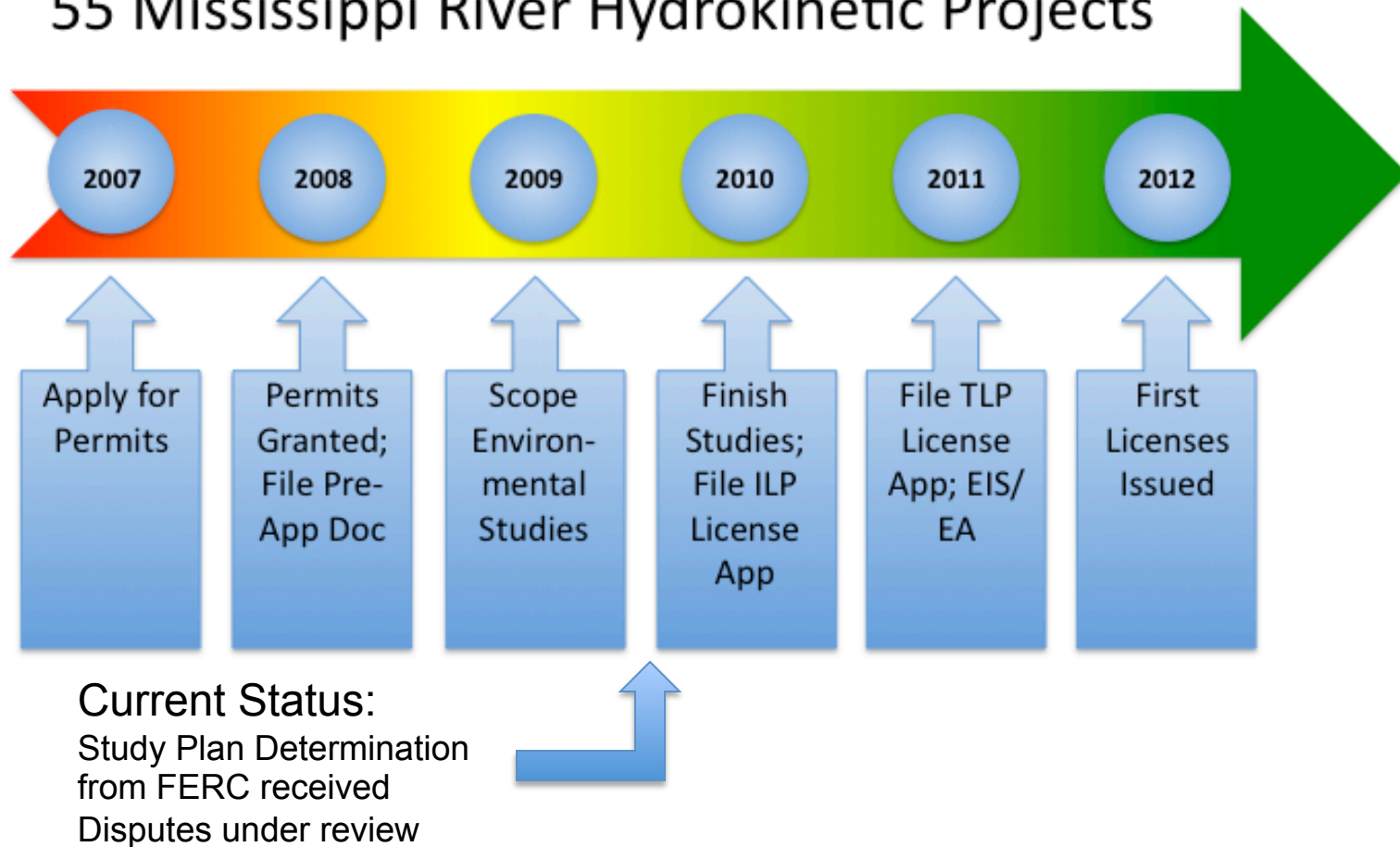
Rivers Are More Immediate Than Oceans

- Closer to consumers and transmission
- Lower construction costs
- Fewer engineering problems (consistent, unidirectional flow)
- More confined environmental issues (species data)



Commercialization of Licensed Hydrokinetics

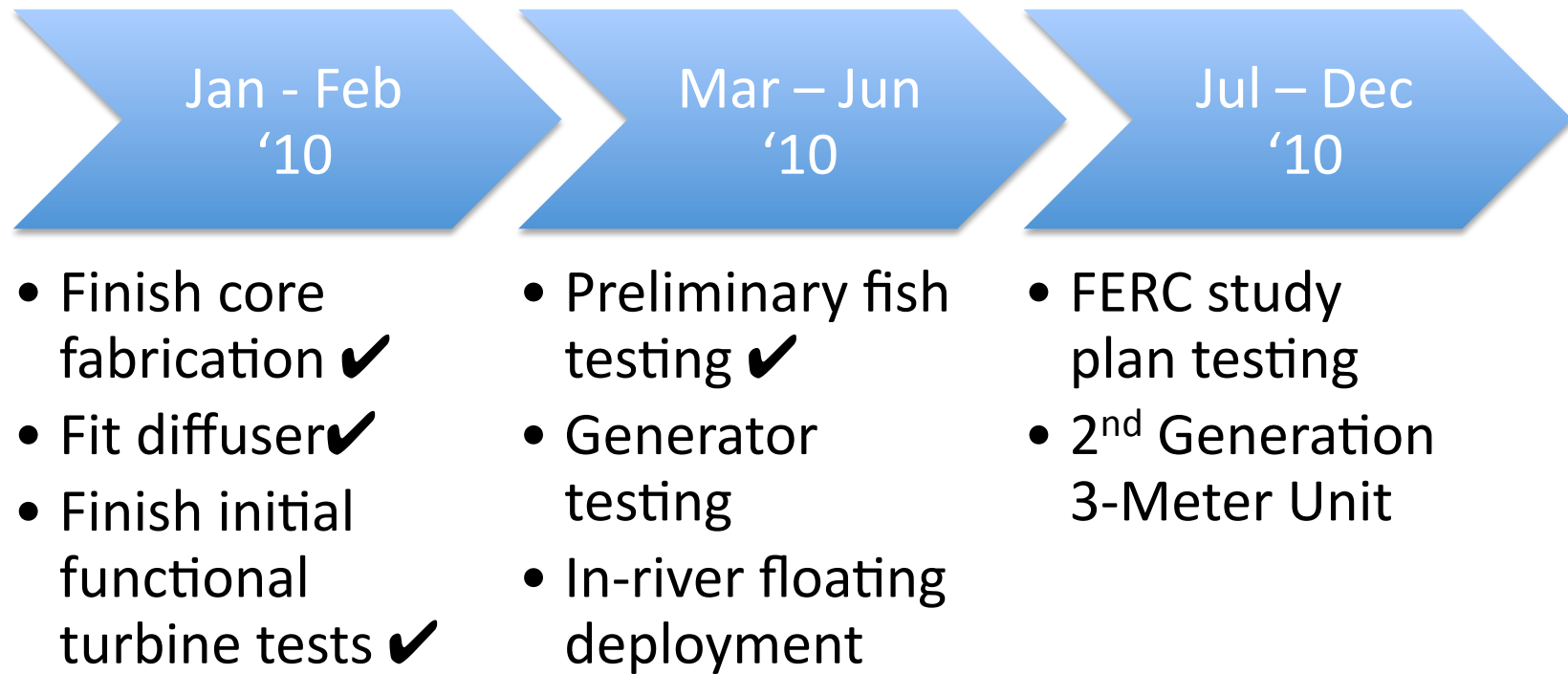
55 Mississippi River Hydrokinetic Projects



FERC Study Plan Determination

Study Title	Site Independent or Specific
Turbine Siting Study	Both
Navigation Study	Both
Hydraulic Study	Both
Fish Entrainment Study	Independent primarily
Damage Turbine Recovery Methods	Independent
Electromagnetic Field (EMF) Study	Independent primarily
Vegetation, Wildlife Habitat & Noxious Weeds Inventory	Both
Commercial Fishing & Recreation Study Plan	Both
Archeological & Historical Resource Investigation	Both
Acoustic Energy Study Plan	Independent primarily
Rare, Threatened & Endangered Species Study	Both

Updated SmarTurbine™ Development 2010 Plan



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