



KINECTRICS

**PILOT PROJECT EVALUATING THE PERFORMANCE OF
A REVERSED LOUVER AND ANGLED FINE MESH
SCREEN IN REDUCING IMPINGEMENT AND
ENTRAINMENT AT BAY SHORE POWER PLANT**

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Confidential & Proprietary Information

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Table of Contents

	Page
1 INTRODUCTION AND OBJECTIVE:	3
2 PREDICTING THE EFFECTIVENESS OF A LOUVER ARRAY IN DIVERTING FISH	3
2.1 BIOLOGICAL ATTRIBUTES	3
2.2 DESIGN CONSIDERATIONS FOR FISH PASSAGE	4
3 TECHNICAL APPROACH AND SCOPE OF WORK	6
4 PROJECT MANAGEMENT METHODOLOGY	15
5 THE KINECTRICS TEAM	15
6 QUALITY MANAGEMENT SYSTEM	16
7 SCHEDULE AND DELIVERABLES	17
7.1 SCHEDULE	17
7.2 PROJECT DELIVERABLES / MILESTONES	18



1 INTRODUCTION AND OBJECTIVE:

A preliminary evaluation of various mitigation options for reducing fish impingement (I) and entrainment (E) at Bay Shore Power Plant was conducted by Kinectrics in 2008 (Ager and Lin 2009). A louver system with culvert bypass offered maximum predicted reduction for impingement. A follow-up study suggested that further modifications to the louver (smaller slat angle, smaller open spacing and placement of a solid bottom overlay) and a fine mesh angled screen placed behind the louver may offer further entrainment and impingement reductions (Lin and Patrick 2010).

The objective of this study is to conduct a pilot project in the Bay Shore intake channel using a reversed louver and angled fine mesh screen, and determine its effectiveness in reducing I/E. The pilot project is expected to commence in April 2010 with evaluations occurring during the spring, summer and possibly fall periods. There are four (4) tasks:

Task 1. Develop design criteria and design the reversed louver array and fine mesh angled screen for the pilot project (i.e. "the fish protection system").

Task 2. Install the proposed fish protection system safely in a location similar to that expected for a full-scale implementation (assuming a full-scale project proceeds)

Task 3. Evaluate the performance of the fish protection system for both I/E reductions. The entrainment component will be evaluated in collaboration with the University of Toledo and various government agencies (O-DNR, USGS, and NOAA_GLERL).

Task 4. Analyze data and prepare a report including recommendations of the performance of the fish protection system.

2 PREDICTING THE EFFECTIVENESS OF A LOUVER ARRAY IN DIVERTING FISH

Performance of a louver is dependent on many variables some of which are related to engineering design of the array whereas others are biological in nature and focus on fish attributes such as size, life history stage, and response to stimuli such as turbulent flows. Relevant factors for consideration for the proposed pilot project at Bay Shore Power Plant are outlined below.

2.1 Biological Attributes

- **Species** (predator/prey, pelagic/ demersal). Species specific responses will occur with some species showing much greater diversion than others. This is a typical feature of any behavioral system (e.g. Patrick et al. 1985, Patrick and Poulton 2001), and the design must consider the behavior of the target species (i.e. dominant species impinged and/or entrained).



- **Life History Stage** (YOY, juvenile, adult). Differences in response to a louver array can occur for life history stage even within the same species. Diversion efficiencies will vary not only in relation to differences in life history behavior (e.g. attraction or avoidance to flow) but also swim speed capabilities (which is a function of size and life history).
- **Swimming Abilities of Specific Fish:** Both sustained and burst speeds need to be considered. Burst speed can be metabolically demanding for fish, and distance travelled may be relatively small relative to the size of the diversion bypass (Scruton and McKinley 1998). Hence, fish become fatigued and would be vulnerable to passage through the louver slats.
- **Schooling Behavior vs Individual Responses.** Improved effectiveness will be expected for fish approaching as a school as opposed to individuals or small groups. High fish impingement usually involves schooling species with large numbers.

2.2 Design Considerations for Fish Passage

- **Approach Velocity:** Average water velocity measured a few meters in front of the intake screen taken in the same direction as the general flow. The approach velocity should be low as possible to allow fish sufficient time to elicit an avoidance response).
- **Sweep or Bypass Velocity:** Average velocity that sweeps along the louver array. This velocity should be directed towards some sort of bypass and should exceed approach velocity for passive diversion to occur.
- **Slat Velocity:** Slat velocity is the average velocity that passes through the louver slats. This velocity may exceed the sustained swimming velocities of the fish species but not always the burst speed of fish. The higher the slat velocity, the more difficult it will be for fish to bypass especially if approach velocities are high, and fish become fatigued.
- **Slat Angle:** This is the angle that the slat is attached to the frame, and is measured either relative to the frame or flow. It is well documented that slat angle can affect performance of the louver system (Griffiths 1981, EPRI 2001).
- **Slat Spacing:** Louver spacing is the "clear" opening area of a louver array, and will typically vary from 5 to 30 cm. It is well documented that slat spacing will affect performance of the louver system (Griffiths 1981, EPRI 2001).
- **Current Velocity:** Velocities will vary substantially at each power plant especially hydroelectric facilities (Odeh and Orvis 1998). If velocities far exceed the



sustained swimming capabilities of the fish a low performance of the louver may be expected.

- **Frame Angle:** Louver frame angle is the angle of the louver array to the flow. It can be important in determining sweep velocity along the louver array.
- **Pressure Gradient:** Fish have ability to detect small pressure gradients which are required for a fish avoidance response.
- **Turbulence:** An area of turbulence should be created. However, the turbulence created should exceed the "attraction flow" to fish (Coutant 2001) and cause an avoidance response. Attraction flow should be considered at the bypass not through the louver slats.
- **Space Perception Cues:** In addition to flow, visual and/or space perception cues should be provided to maximize diversion effectiveness. The intent is to develop a multi-sensory approach whereas fish would be able to respond to more than stimuli (in this case, flow and visual). Maximizing the length of the louver slat is one approach to create a space perception cue.
- **Water Temperature:** Fish swim speed capabilities and behavioral responses are temperature dependent (discussed further below).
- **Bypass Design:** The bypass design is also critical in the louver design. Factors considered important include location, type (surface vs full depth), size, sweep velocity along louver to bypass, attraction velocity (at bypass), and quantity of flow.

Swimming speed varies primarily by fish size and water temperature, with small fish and those at cold temperatures performing most poorly. Overall, a fish's ability to avoid impingement depends on its swimming ability relative to the velocities in the flow field and the distance it needs to swim to reach a safe area (EPRI 2000).

Blaxter (1969) concluded that the cruising speed for most fish is between 2 to 3 body lengths per second (BL/s). Sustained swimming speeds for fish species impinged at Bay Shore Power Plant were estimated based on the mean body length of impinged specimens. The dominant species (>90%) impinged at Bay Shore have estimated sustained swimming speeds that exceed the ambient flows in the intake channel at 11-12 cm/s (emerald shiner-13 cm/s; white perch 20 cm/s; gizzard shad 21 cm/s; white bass 20 cm/s). This should allow fish time to display an avoidance response to the louver array without becoming excessively fatigued.



3 TECHNICAL APPROACH AND SCOPE OF WORK

3.1 Proposed Fish Protection System

The proposed pilot study at Bay Shore will include a unique fish diversion system which will incorporate features such as a reversed louver, an impermeable guiding wall (bottom overlay), a fine mesh angled screen and other design features as listed below. The primary function of these components is to divert impinged fish, possible fish eggs and larvae as well as divert debris. The fine mesh screen system is proposed to be placed behind the louver array to divert entrained organisms. Design features are illustrated in Figures 1-2 and are described in more detail below.

- **Reverse Louver:** The louver configuration will operate in a more “reversed” mode which will act better as a debris diverter as well as dead and/or semi-moribund fish. Studies conducted earlier by Kinectrics suggest that efficiencies as high as 90-95% can occur with a 30 degree orientation (in a reversed mode). The optimal slat angle for the Bay Shore pilot project will be 120 degrees to flow.
- **Slat Spacing:** A 10 cm spacing is proposed for high impingement diversion. There should be some concern with clogging from zebra mussels and other biofouling organisms. The maximum fouling of mussels on a structure without any biofouling protection is expected to be about 6 cm. **Slat Length:** The slat length will be 30 cm to create a “space perception” cue which should result in improved performance for fish diversion. Earlier studies have shown that certain species of fish tend to avoid close openings (space perception and visual cues) especially when approaching in schools as opposed to individual responses (Patrick and Rkman-Filipovic 2004).
- **Frame Angle:** The frame angle will be about 27 degrees based on modeling results (Lin and Patrick 2010). This should allow sufficient sweep velocities along the louver array.
- **Bottom Overlay/Guiding Wall:** Guide walls involve the use of an impermeable barrier that introduces a strong downstream current in the direction of the bypass channel (Oden and Orvis 1998). They are solid obstructions in the flow field which cover only a portion of the water column, and are angled similar to a louver array. In EPRI lab studies (2001) performance of both louver and bar rack diversion systems had increased an additional 30% to over 90% in some instances. The bottom section of the louver array for the pilot project will be impermeable or solid; however, conceptually similar to the bottom overlay used in the EPRI studies. It is expected that the bottom ¼ of the louver array will be solid.



- **Bypass Design:** The pilot project will not consider a bypass design since the pilot involves only a section of louver to be tested, and only in part of the intake channel.
- **Fine Mesh Angled Screen:** This screen will be placed approximately 2.0 m behind the louver array and will have a mesh size of 6.4 mm. Fine mesh screens have been shown to be effective in reducing I/E. For example, 9.4 mm mesh screens have been evaluated for Carolina Power & Light Company's Brunswick Steam Electric Plant at Southport, North Carolina (Thompson, 2000). With the fine-mesh (1mm) screen in place, entrainment was reduced by as much as 80%.

3.2 Pilot Engineering Design and Installation

This pilot evaluation of the reverse louver concept is best demonstrated by installing a section of the reverse louvers in the inlet water channel at Bay Shore. The louver assembly would be located between the marina and the intake trash racks. The objective of the trial is to generate data on performance for avoidance of fish impingent and entrainment. The most cost effective way to achieve this requirement is to design and construct a temporary set of louver panels designed to last one season and only large enough to produce representative data. Since these panels will be removed at the end of the season, attempts are made to minimize the amount of infrastructure required to secure the panels in order to keep installation costs down and removal costs to a minimum. By placing the panels near shore most of the installation effort can be accomplished with a crane from shore rather than employing more expensive marine mounted equipment. Minimizing the channel obstruction is also considered by placing the louvers on one edge of the channel and extending out only about 40 feet from shore.

- **Minimal Infrastructure:** The entire pilot array is being designed without the need for pilings or permanent anchors. It is intended to design and build the array robust enough for only one season. A system constructed of materials to result in a longer multi year life expectancy would be at a much higher cost. The use of wood for the slat material creates some buoyancy as opposed to steel or aluminum construction.
- **Multiple Technologies:** The pilot will combine the reverse louvers, guiding wall and fine mesh screen technologies with a sampling plan capable of comparing the individual technologies as well the combined effect.
- **Unknown Site Conditions:** The conditions of the channel bottom are unknown. The depth of mud and the soil conditions for pile installation are not known. Without access to core samples for the area it is difficult to consider installing any pilings for anchoring or supporting a louver array. For this reason to avoid costly core sampling, retaining wall concrete blocking will be used as anchors.



- **Sampling Access:** There is enough access around the pilot structure to allow for sampling before the louver, after the louver but before the fine mesh screen, and after both the louver array and the fine mesh screen. This provides data to show the general impact of each technology individually and combined.
- **Loading on the Louver Panels:** Keeping the panels near shore results in shallower water and therefore lower forces on the panels and easier access for installation. The anchoring and floatation required is also reduced.

Tasks for Demonstration

1. Carry out a pre-pilot baseline sampling program in the near vicinity of the proposed pilot installation.
2. Site visit to confirm the design and installation principles in the channel, channel bank stability, bypass channel design, site access for construction, request for channel profile drawings.
3. Design and construct reverse louver panels, twenty feet long with a steel frame and 12" wide 3/4" plywood slats. Panels must hook together and be part of a floating system. Use of crown floats for surface floatation. Design a fine mesh screen to be attached to one louver section.
3. Make a guiding wall section to block the near shore water from 0 to 20" depth, approximately 20' long.
4. Establish an anchoring system to hold the panels near shore and to hold them in place in the channel. Concrete anchors with steel cables (pending a site visit).
5. Transportation of all materials to site.
6. The construction and installation of the pilot louver panels and anchoring system including the requirement for a large mobile crane and a small tug boat with a diver crew.
7. Install a fine mesh screen 6 feet behind one of the 20 foot louver panels.
8. Removal of all equipment at the end of the season.
9. Disposal of louver panels.

Figure 1. Proposed Pilot Trial Layout

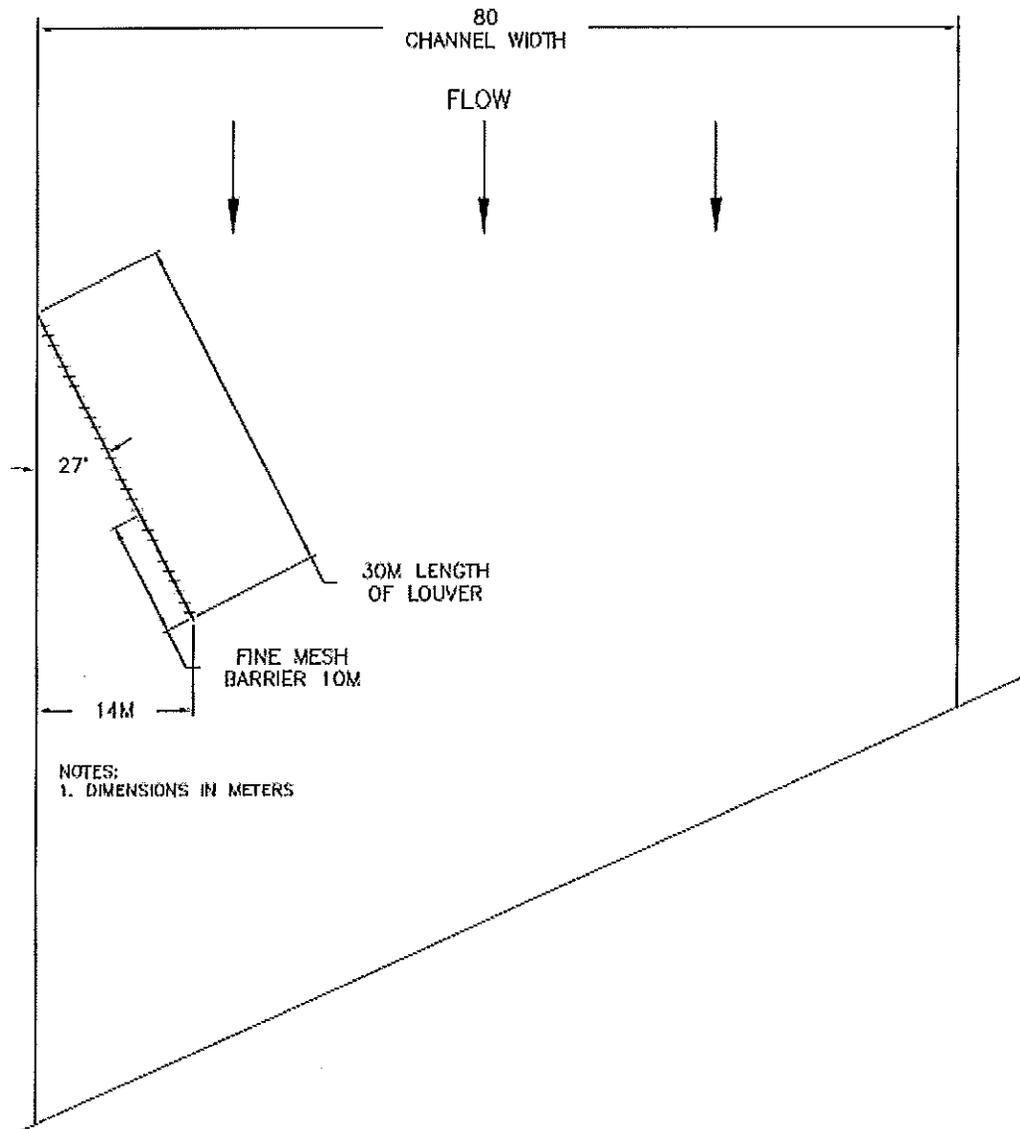
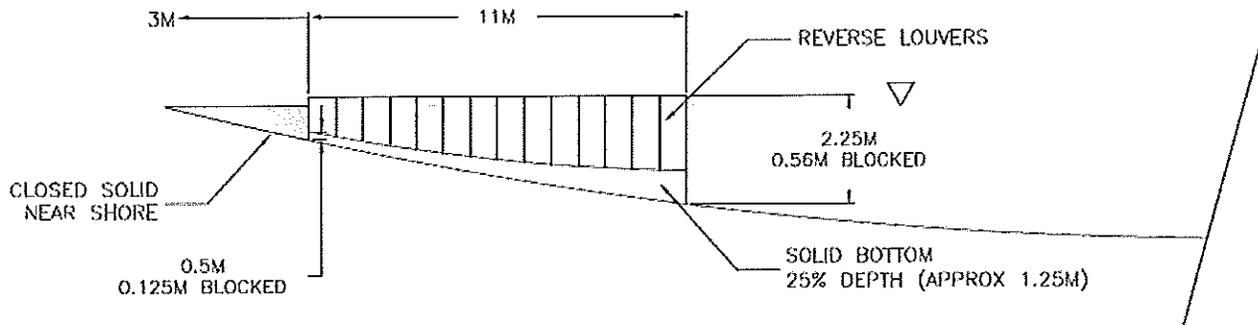


Figure 2. Proposed Pilot Trial – Side View



- NOTES:
1. DIMENSIONS IN METERS
 2. LOUVER SPACING NOT TO SCALE



3.3 Performance Evaluation of the Fish Protection System

3.3.1 Entrainment

The effectiveness of the fish protection system will be evaluated using traditional ichthyoplankton nets (363 micron mesh, 0.5m diameter). Results will be compared to ongoing larval fish studies being conducted by the University of Toledo (U of T) and an agency consortium.

Fixed Ichthyoplankton Nets (Kinectrics)

Prior to the installation of the fish protection system, control entrainment samples will be collected at four (4) locations for both upper and lower depths (total of 8 net locations). Samples will be collected during both day and night periods for a total of 16 control samples. This will enable a determination of the spatial distribution of fish eggs and larvae within the water column (e.g. predominantly at surface or bottom). Results from this study will be used to determine the optimal location of nets for the effectiveness evaluation (see below).

Egg and larval fish relative abundance both in front of and behind the fish protection system (louver and angled screen components) will be determined using seven (7) fixed nets (363 micron mesh, 0.5m diameter, Figure 3). These nets will be employed twice per week over the April to June (13 week) period. Samples are expected to be of short duration 8-12 hr, and will be collected during both day and night periods. This will allow a statistical comparison of effectiveness during both day and night periods to determine if a diurnal effect is also occurring (Table 1). Each net will have a flow meter which will determine the actual flow into each net so that abundance estimates can be quantified, and differences in flow between nets can be quantified. It should also be possible to provide an estimate of diversion efficiency based on the egg and larval catch relative to the positioning of nets.

There may be some bias in larval fish estimates using a fixed technique based on the intake velocities. Older larvae (>20 mm) of many fish species entrained at Bay Shore, have the ability to display burst speeds (speed attained in short sprints) up to 15 cm/s, and hence may be capable of some avoidance responses to both the louver system and the fixed ichthyoplankton nets. These larvae also have sustained swimming speeds (speed at which fish swim for extended periods of time) averaging above 2 cm/s (Miller *et al.* 1988, Klumb *et al.* 2003). The estimated average current in the intake channel is 11 cm/s so some avoidance may occur for these larger larvae especially in late spring sampling. We should be able to verify this bias, if any, based on comparison of results between fixed and mobile ichthyoplankton net surveys (see below). However, this potential bias is not expected to affect fish egg distribution and numbers, and most larval fish collected.

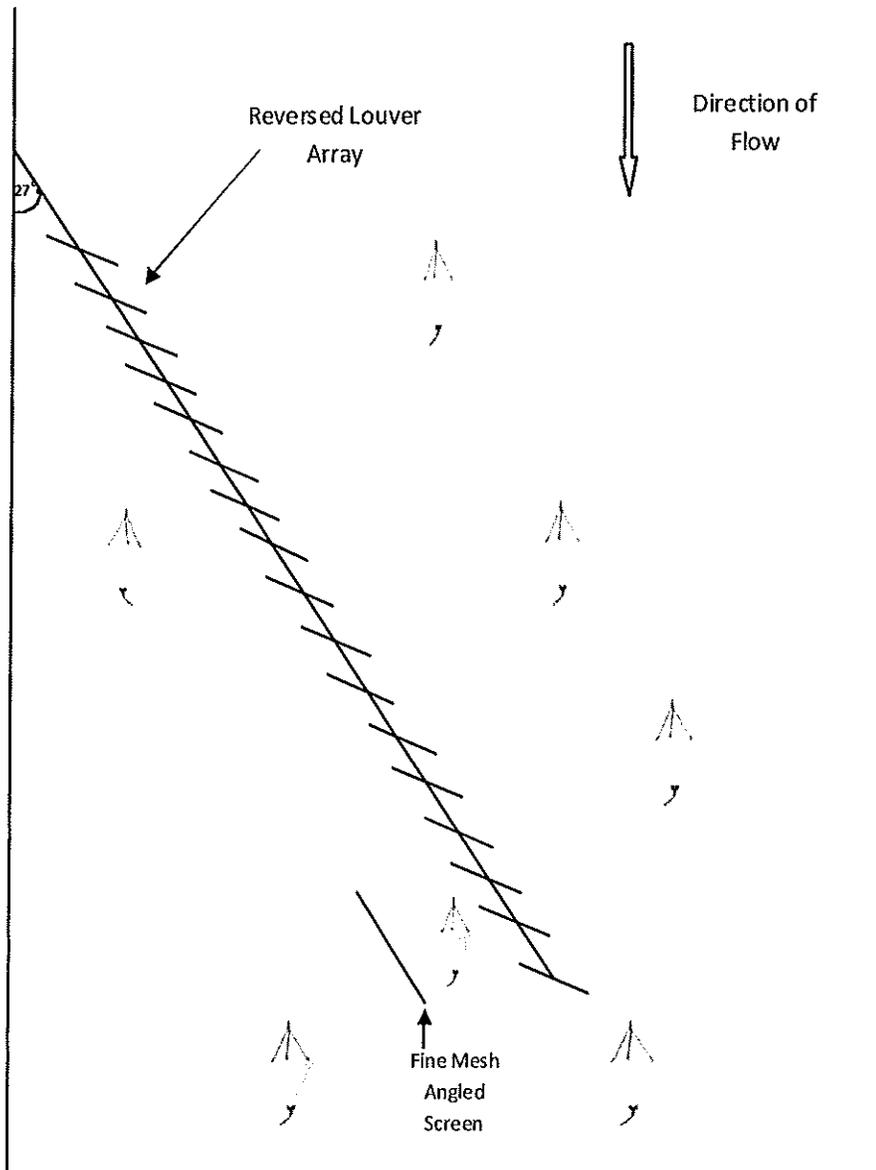


Figure 3. Preliminary Design for Location of Fixed Ichthyoplankton Nets (n=7) in Intake Channel, Bay Shore Plant

Table 1. Summary of Sampling Design for both Entrainment and Impingement Sampling

TECHNICAL FOCUS	SAMPLING METHODOLOGY	NUMBER OF SAMPLES	COMMENT
BASILINE ENTRAINMENT	Fixed Ichthyoplankton Nets (8)	March: 16 samples (4 locations x 2 depths x 2-12h samples)	<ul style="list-style-type: none"> Provides spatial distribution of fish eggs and larvae
ENTRAINMENT	Fixed Ichthyoplankton Nets (7)	April-June: 182 samples (7 locations x 2-12h samples/week x 13 weeks)	<ul style="list-style-type: none"> Addresses both fish eggs and larvae May be some bias in collecting larger fish larvae Will be compared to mobile ichthyoplankton net sampling and fixed hydroacoustic sampling (U of T consortium)
IMPINGEMENT	Gill Nets (various mesh sizes)	April-June: 52 samples (2 locations x 2-12h samples/week x 13 weeks) July-Sept: 26 samples (2 locations x 2-12h samples/bi-weekly x 13 weeks)	<ul style="list-style-type: none"> Mesh sizes and placement to be finalized (likely ½ to 2 ") Will be compared to fixed hydroacoustic sampling (U of T consortium)
IMPINGEMENT	DIDSON ACOUSTIC CAMERA	May: 2-5 days (Day versus Night)	<ul style="list-style-type: none"> Evaluation of the behavioral response of fish to the fish protection system

Mobile Ichthyoplankton Nets (Consortium)

A consortium consisting of the University of Toledo (U of T) and various government agencies (ODNR, USGS, NOAA-GLERL) is conducting larval fish studies to determine the numbers of larval fish entrained at the Bay Shore Power Plant from April to June (Mayer et al. 2009). Larval fish species composition and abundance are proposed to be determined by collecting samples with ichthyoplankton nets (500 microns, 1.0 m diameter) towed in 3-5 transects in the Maumee River, intake channel above the louvers as well as in the discharge channel. Samples will be collected weekly from April to June. The focus on this study is larval fish not fish eggs. The 500 micron being used by the consortium is biased in the collection of eggs for all fish species (Auer 1982). Therefore, the comparison with the fixed ichthyoplankton nets will be based on only larval fish collections.

Hydroacoustic (Consortium)

The consortium is also deploying fixed station hydroacoustics at two stations, one of which will be in the intake channel above the fish protection system (Mayer et al. 2009). Sampling will be conducted during the months of April, May and June. Hydroacoustics can provide a continuous measure of the density and size distribution of fish that compares well to other sampling methods (Rudstam et al. 2002). The equipment will be positioned so that most of the water column can be monitored. The consortium will calculate the number of larval fish exiting the Maumee River based on *fish density x river discharge*. They will estimate river discharge based on data from the USGS monitoring station in Waterville, OH, this web-based data is available in real time ([http://waterdata.usgs.gov/usa/nwis/uv?site no=04193500](http://waterdata.usgs.gov/usa/nwis/uv?site%20no=04193500)). They will also calculate the number of fish entering the power plant based on *fish density in the channel x channel flow*, and estimate the amount of water flowing through the channel based on channel morphometry and measurements of flow rate taken during sample collection of larval fish.



The use of this data set and comparison to the fixed ichthyoplankton nets and DIDSON system being used by Kinectrics will still require discussion with the consortium and FirstEnergy.

3.3.2 Impingement- Gill Nets (Kinectrics)

Nets will be placed both in front of and behind the fish protection system on alternate days within the week (12h day sample, 12h night sample). Sampling frequency will be as follows:

- April – June: 2 samples per week (1 day, 1 night)
- July – Sept: 2 samples bi-weekly (1 day, 1 night)

Gill nets consisting of various mesh sizes ranging from ½ to 2 in will be used as part of the evaluation. It is expected that set duration will be about 12-hr, and data will be collected during both day and night periods (to determine diurnal effect). An estimate of performance will be based on a statistical comparison of fish species and CUE for each week in each month period.

3.3.3 DIDSON (Kinectrics)

Over the past few years, significant improvements have been made to acoustic technology for monitoring fish movement and behaviour much of it being declassified from the US military. One technology, the DIDSON acoustic camera (Dual Frequency IDentification SONAR), has the ability to operate in turbulent and turbid environments such as intake structures and discharges of power plants. The operating frequencies of this new device (commercialised from US Navy) are between 1.1 to 1.8 Mhz using 48 beams which allows "ultrasonic" images of fish and other aquatic life such as filamentous algae in the water column. The beams are adjacent to each other and together form a field-of-view 29° horizontal and 14° vertical. The DIDSON acoustic camera offers a significant advantage over more traditional sonar systems including imaging sonar equipment (e.g. Imagenex Model 837 Digital Fast Sonar) which has difficulty in identifying targets, and cannot adequately distinguish debris from fish. DIDSON has the ability to have near-video quality of fish, and has counting software which allows assessment of both schools and individuals. Currently, several investigators are using this technology as an alternative to standard sonar equipment for monitoring fish behaviour and movement in rivers or channels which are fast flowing (Cronkite et al. 2005, Holmes et al. 2006). It has also been successfully used behind the trash racks of Alabama's Power Barry Plant on the Mobile River (Garrett 2006).

A DIDSON acoustic camera will be positioned both in front of the fish protection system and behind to evaluate the behavioral response of fish to the fish protection system. It is expected that this evaluation will occur over a 2-5 day period in May documenting both day and night periods. Results will be compared to the gill netting data as well as the



hydroacoustic survey conducted by the University of Toledo and agency consortium during the May assessment.

4 PROJECT MANAGEMENT METHODOLOGY

Project Management is a core process at Kinectrics and is promoted within the company as a discipline with a career path and appropriate rewards for success. Our methodology is based on best practices drawn from the Project Management Institute (PMI), other industries and companies and our own past successes. Competence within the company is based on:

- Training in basic PMI methodology for all professional staff with project responsibilities and advanced training for Senior Project Managers
- A core team of accredited Senior Project Managers, who manage large contracts and also act as supervisors and coaches for other staff
- Information systems to support cost control and resource management;
- Project reviews carried out by senior management

Good Project Management practice is applied to all projects in Kinectrics and includes:

- Project Definition – objectives, resource requirements, chain of command
- Project Planning - scheduling, cost estimation, risk assessment, quality and safety, use of project management software to plan and track the project progress as appropriate
- Project Control - progress measurement, communication, change control, status reporting and project documentation

5 THE KINETRICS TEAM

Robert Reesor, Senior Engineer. Design and Construction Supervisor. Robert Reesor was the Construction Supervisor for the 2006 and 2009 barrier net installations at Pickering NGS. He will be responsible for the safety, quality assurance and day to day oversight of the field crew. Bob was also the Construction Supervisor for a \$10M installation of the Sorbweb Oil spill containment system at Bruce Power. Kinectrics installed spill containment around the service and control transformers for all eight units at Bruce Power. The construction crew averaged from 8-36 men over a one year timeframe. Kinectrics was responsible for the design phase, implementation, and construction of the complete solution.



Darlene Ager, PhD. - Project Manager. Dr. Ager will be the project manager on this project, and will be responsible for scheduling, project cost control, budgets and ensuring that the project technical requirements and quality are met. She has over 15 years experience dealing with environmental and project management issues at Kinectrics and its predecessor companies. She has developed SOPs, QA/QC plans and has managed 316(b) studies for a number of US facilities.

Paul H. Patrick, PhD. – Technical Project Advisor and Report Preparation. Dr. Patrick will be the technical advisor for this project, and will be involved in the initial meetings along with the Kinectrics team, FE and the University of Toledo consortium to integrate field evaluation. He will also be responsible in preparation of the final report. Paul has been directly involved with I/E reduction technologies and other environmental issues at stations in the US, Canada and Japan for over 30 years. He is currently involved with providing impingement reduction technical solutions (both short term and long term) for the barrier net system at Pickering Nuclear, the acoustic system at Lambton Power Plant as well as intake related issues for several other power plants in the US. He also recently managed a multi-disciplinary project with We Power on development of a conceptual design for the modified porous dike intake structure for the Port Washington Plant on Lake Michigan. He was also the project manager on several I/E sampling programs in the US.

Dr. Patrick has completed BTA reviews for FirstEnergy (at six Plants including Bay Shore), the New Jersey Department of Environment Protection (NJDEP) for PSE&G's Salem Plant (who received their NPDES permit), and has recently completed BTA reviews for other power plants in the US (e.g. Pacific Corp, WE Energy, Alabama Power and Cinergy). Paul is internationally known for developing and implementing fish diversion systems, having worked for EPRI, NYPA, ESSERCO, We Power, Consumer Energy, Alabama Power, We Energies, Detroit Edison, PacifiCorp, Ontario Hydro/Ontario Power Generation, Bruce Power, BC Hydro, TransAlta, and the Norwegian Utility Group. He has published over 75 reports in this area, and has produced over 20 referred publications on fish behavior and methods to reduce fish impingement at power plants.

6 QUALITY MANAGEMENT SYSTEM

Our Quality Management System is registered to ISO 9001:2000 by QMI, a division of CSA and North America's leading QMS registrar. Our adherence to this standard provides one of the strongest assurances of service quality available.

As a minimum, all work at Kinectrics is performed to meet the requirements of ISO 9001. The application of the methodology is customized to the needs of each individual project to ensure an appropriate level of quality management. Quality is maintained through regular review and frequent internal audits. Customers may review the program at any time.

Specific services are performed under Quality Assurance programs operating in conjunction with ISO 9001. For example, our Analytical and Environmental Services Laboratory is accredited by the Standards Council of Canada as conforming to ISO Standard 17025. Our N285 QA program for the supply of nuclear pressure retaining



systems and components in CANDU nuclear power plants has been certified by the TSSA. For US clients involved in nuclear safety-related work, we maintain a 10 CFR 50 Appendix B program.

Customers have audited our ability to supply at quality levels prescribed by additional standards including, for example, CSA Z299.2 and N286.2. We are also working toward accreditations in metrology and electromechanical testing services (ISO 17025).

Kinectrics Quality Program (QA Manual Revision 9 dated 26 May 2004) has been audited and accepted by Ontario Power Generation.

Kinectrics' Quality Management System



Kinectrics ISO 9001:2000-based Quality Management System is registered with QMI, a division of CSA and North America's leading QMS registrar. As a minimum, all work at Kinectrics is performed to meet the requirements of this standard. Our adherence to ISO 9001 provides one of the strongest assurances of service quality available. Under this Quality Management System, project quality management is customized to match the needs of individual projects to ensure appropriate levels of quality. Customers and Kinectrics' quality assessors may audit the quality records at any time.

Kinectrics manages several additional quality programs to meet the requirements of a Nuclear power plant owner. These programs have been audited by OPG and meet the applicable portions of N286.0 to N286.6. For Canadian Nuclear work, Kinectrics follows its "Nuclear Quality Assurance Manual" based on the requirements stated in N285.0, namely ASME NCA4000 and NQA-1.

Specific services are performed to additional standards operating in conjunction with ISO 9001. For example, our Analytical Chemistry and Environmental testing services group is accredited by the Standards Council of Canada as conforming to ISO Standard 17025.

7 SCHEDULE AND DELIVERABLES

7.1 Schedule

ACTIVITY (2008)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Design / Fabrication		■	■									
Installation			■									
Entrainment Study				■	■	■						
Impingement Study				■	■	■	■	■	■			
Optional Impingement										■	■	■
Didson Analysis					■							
Optional Didson											■	



7.2 Project Deliverables / Milestones

The following table provides a summary of key project deliverables and milestones (optional studies have not been included).

Project Deliverables / Milestones	Date
1. Site Visit	February, 2010
2. Completion of Design Drawings	February, 2010
3. Fabrication of Fish Protection System	March, 2010
4. Installation of Fish Protection System	April, 2010
5. Completion of Entrainment Study	June, 2010
6. Completion of Impingement Study	September, 2010
7. Draft Report	December, 2010

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