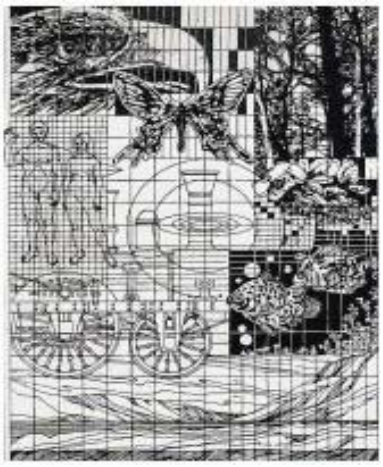

Environmental Consulting
INSIGHTS

KEYSPAN GENERATION LLC STUDIES THE SUBSTRATUM INTAKE SYSTEM
An Innovative Water Intake System for Power Generation Facilities

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An Electronic Newsletter of EEA's Environmental Consulting Activities
Spring 2005

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EEA services include Phase I ESAs, Haz-Mat Testing and Remediation, Wetlands Delineation and Creation, Natural Resources Inventories, Marine Ecology Studies, Air Quality and Noise studies, and Environmental Management System (ISO 14000) implementation.

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Feasibility Study Completed

Since December 2004, a team of staff scientists, engineers, and hydrologists have been researching the use of substratum intakes that could be drilled into the saline aquifer beneath Long Island Sound. Led by EEA's Dr. Roy Stoecker, the method will utilize the bottom of the Long Island Sound as a giant sand filter bed to result in an effective reduction of 100 percent in entrainment and impingement of marine life. The network of directionally drilled well screens will capture saline groundwater from the sandy layers underneath the Sound to be used as cooling water. Significant thermal efficiency benefits are thought to result from the availability of cooler water during the summer peak generating demand. The resulting study, the first of its kind, was recently completed and submitted to Keyspan. Other members of the study team included:

- Michael K. McEachern, P.G. - MC Environmental,. Hydrogeology
- Robert Holzmacher, P.E. J.R. Holzmacher P.E., LLC. Well and Hydraulic Engineering,
- James Rumbaugh, Environmental Solutions – Groundwater Modeling

This study determines the feasibility of pumping up to 700,000 gallons per minute from a Substratum Intake Structure (SIS) consisting of horizontal wells drilled beneath Long Island Sound from land on the Keyspan Northport (5,000MW) facility. If the SIS proves to be feasible, it will provide both energy and regulatory compliance benefits over competing technologies without significant construction or operational environmental impacts.

ENR Gives Substratum Intake System a Boost

Only two weeks after presenting the Substratum Intake System to USEPA officials in Washington, Engineering News Record (ENR) provided some of that impetus when it reported in April that Keyspan scientists considered the concept promising.

"We're grateful to ENR for the national press coverage" said Dr. Stoecker; "few people know that our system represents one of the few options to meeting the standards and the intent of EPA Regulations under 316 (a) and (b). We hope the industries impacted under 316 will take the time to fully examine how effective the system can be without dealing a crushing blow to power generation efficiencies. There are few win-win situations for both the economy and the environment in our business. This, clearly, could be one of them". See ENR News Article.

The plan was to conduct the study in a phased, methodical, cost effective manner concentrating on the elements most likely to have possible fatal flaws before proceeding to the more straight forward engineering subtasks. The overall major elements of this feasibility study are as follows:

- Hydrogeology Investigation
- Groundwater Modeling
- Conceptual Engineering and Cost Projections
- Regulatory Agency Consultation
- Report and Recommendations for Future Studies

Over the past two years, Team staff scientists, engineers, and hydrologists have been researching the use of substratum intakes that could be drilled into the saline aquifer beneath Long Island Sound. This method will utilize the bottom of the Long Island Sound as a giant sand filter bed to result in an effective reduction of 100 percent in entrainment and impingement of marine life. This large network of directionally drilled well screens will capture saline groundwater from the sandy layers underneath the Long Island Sound to be used as cooling water. Significant thermal efficiency benefits will also result from the availability of cooler water during the summer peak generating demand period. Using water from a saline aquifer (as opposed to surface waters) has several obvious environmental and operational advantages:

- No entrainment of zooplankton or fish eggs and larvae. Since the well screens are buried beneath the sand substrate no biological forms would be entrained into the plant.
- No impingement of adult fish and larger invertebrates on the traveling screens.
- No necessity for biocides since the incoming water will be

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EEA, Inc. –
Founded in 1979

Principals

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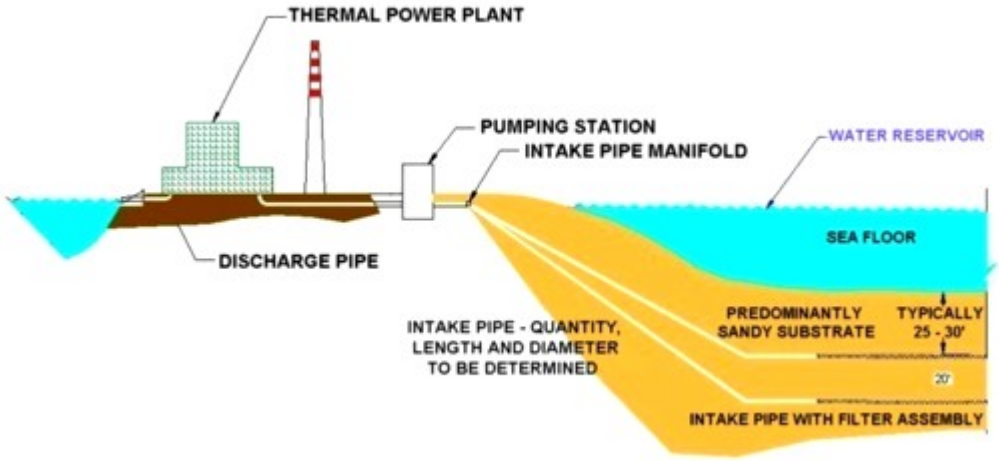
President

Allen Serper, M.S., P.E.
Vice President

Roy R. Stoecker, Ph.D.
Vice President

essentially sterile.

- No thermal plume during the summer months because the substrate water will be significantly colder than the surface waters. This also obviates the need for additional circulation pumps as dilution water sources.
- Increased thermal efficiency and reduced maintenance compared to surface water intake systems and greatly increased efficiency compared to cooling towers.
- Ability to quickly revert to surface water intake if necessary.
- Installation utilizing directional drilling with no marine environmental impacts.
- No major permits required (e.g., water well, tidal wetlands)
- Minimal alterations to present plant cooling system.



Conceptual Diagram of SIS - Substrate Intake System

Hydrogeology Investigation

The first phase was to gather available subsurface geologic data from the power plant, from U.S. Geological Survey reports, bottom studies, including those involving sub-bottom borings, and offshore seismic studies. Available data were used to determine the presence of favorable water-bearing strata necessary to provide the huge volumes required at a typical power plant site. A key element of this subtask was to determine substrate water temperature as well as the seasonal temperature variations of the overlying surface waters presently utilized for cooling at the plant.

Historical USEPA "Guidance" for Once Through Cooling Water Intake Systems (CWIS)

- Avoid wetlands, threatened and endangered species habitat
- Avoid lagoons, coves, etc.
- Keep the screen approach velocity below 0.5 feet per second (fps)
- Avoid "downdrafts" into CWIS (incorporate velocity caps)
- Minimize the time organisms are pinned against screens
- Don't put a high capacity intake in a zone of high biological value

Groundwater Modeling

This subtask involved substrate groundwater modeling to predict the optimal depth of the intake screens. Groundwater modeling also gave invaluable information on how the water withdrawal would change the substrate aquifer characteristics and the expected replenishment time scenarios. The model also can be utilized to assist in the conceptual engineering layout, e.g., how far apart, vertically and horizontally, the well screens should be separated

Conceptual Engineering and Cost Projections

This investigation subtask involved conceptual level design engineering of substrate intake screen lengths and diameters, location of booster pumps, manifolds and similar features of the SIS concept. This subtask was conducted in consultation with site engineers to ensure that all SIS engineering recommendations are feasible from a utility and plant viewpoint.

Following the conceptual engineering layout, estimates of capital and operating costs for the SIS concept were prepared. This subtask will also be conducted in consultation with site engineers familiar with plant construction cost schedules. Cost savings from increases in thermal efficiency will be calculated, assuming the substratum water is lower in temperature than the surface water normally circulated.

Regulatory Agency Consultation

If requested, a formal presentation of the SIS investigations and findings will be made to concerned regulators including the Regional and Federal representatives.

Report and Recommendations for SIS Development

The last subtask of the feasibility study was a detailed report with results and expected benefits of an SIS construction and operation. In addition, if all tasks are successfully implemented, a field investigation plan will be developed that would cover additional exploratory drilling, aquifer testing, and the information that would be necessary to design a working prototype horizontal well. This subtask will include preparation of the design specifications, bid documents, and deliverables needed to proceed with installation and testing of a prototype intake structure.

Presently, Keyspan is reviewing the report and deciding on whether to undertake more detailed programs such as a pilot study and a demonstration project. For more information on the Substratum Intake System contact jmcaleer@eeaconsultants.com

In September of 2004, EEA's Dr. Roy Stoecker presented SIS to the New York State Department of Environmental Conservation Thermal Energy Task Force in Albany, NY and later that month to the Electric Power Research Institute (EPRI) Cooling Water Intake Technologies Conference in Worchester, MA. Both presentations were well received and generated considerable interest

In February and March 2005, Dr. Stoecker presented the SIS concept to USEPA regional and subsequently headquarter officials in Washington concerned with cooling water issues.

Typical Northeast Power Plant

Patent Status

In September 2003, EEA filed an application with the United States Patent Office. The concept is considered patent pending.

25 Years of Service to Government and Industry

In August of 2004, EEA, Inc. (Energy & Environmental Analysts, Inc.) and the founding principals, Leland Hairr, Ph.D., President, Roy Stoecker, Ph.D., Vice President, and Allen Serper, P.E., Vice President, celebrated 25 years as environmental consultants. EEA's client list includes many Fortune 500 companies, as well as state and municipal agencies. A partial list is available at our site at www.eeaconsultants.com

Aerial View of a Typical SIS Design

Related EEA Newsletters:

ENTRAINMENT and IMPINGEMENT? What's That? Power Plants and Cooling Water Intake Structures (CWIS). Winter, 2004.

SUBSTRATUM INTAKE SYSTEM. An Innovative Water Intake System for Power Generation Facilities. Spring, 2004.

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