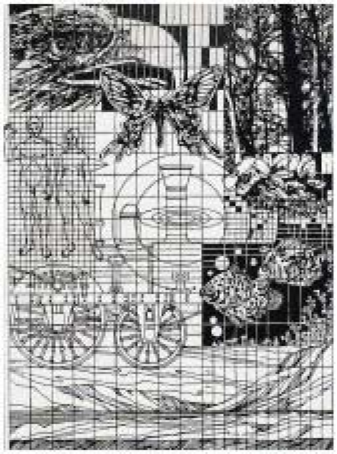

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Environmental Consulting INSIGHTS

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

Revised Regulations Expected Early 2004

(printer friendly version uses Acrobat Reader)

A great variety of industries require water to cool some component o their process train. Historically, however, the electric utility industry has been one of the biggest users of cooling water, as it is needed to condense, for re-use, the steam generated to turn the turbines tha produce electricity in fossil- or nuclear-fueled power plants. The source of this "non-contact" cooling water has always been some adjacen surface waterbody, which often must surrender huge volumes to the plant's CWIS. Most, if not all, of this water is returned to the waterbody but not without possible cause(s) for environmental concern.

Power Plant
New England Coast, Massachusetts

The initial cause for concern centered on thermal pollution, since the cooling water was discharged back to the waterbody much hotter thar when it was withdrawn. Then, people started noticing that large numbers of fish eggs and larvae could be taken into the CWIS with the

Management System (ISO 14000) implementation.

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cooling water (entrainment), and sizeable quantities of adult fish anc shellfish were being killed on the screens protecting the CWIS pumps (impingement).

Roots of Regulations for Cooling Water Intake Structures (CWIS)

To address these concerns, Section §316 was included in the 1972 amendments to the Federal Water Pollution Control Act (PL 92-500). Section §316(a) dealt with thermal discharges (another story), and **Section §316(b) required that the location, design, construction and capacity of cooling water intake structures (CWIS) reflect the Best Technology Available (BTA) for minimizing Adverse Environmental Impact (AEI) of impingement and entrainment.** It was up to the applicant for a CWIS permit to demonstrate that its plan satisfied these conditions.

Sometimes both fish and fisherma are attracted to thermal discharge

Historical "Guidance" for CWIS

- Avoid wetlands, threatened & 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

To do this, applicants had perform a litany of biological studie and consider a variety environmental, engineering desig safety, and cost factors.

The EPA drafted guidanc documents during the mid-seventie to walk the applicant through tl process. Much of the period guidance evolved around stu results that had become kind "rules-of-thumb" for location ar design, such as picking a CW location that had relatively less amounts of eggs and larva minimizing screen approac velocities and avoiding dead-er intake locations.

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Scope of Studies: Some Examples

The most comprehensive, exhaustive and expensive studies were typically associated with existing or proposed nuclear plants, but large coal- or oil-fired plants with CWIS in ecosystems perceived as being fragile, or being ± the epicenter of the spawning or nursery grounds for economically important species (e.g. striped bass), were given equal attention. Biological studies frequently included lab tests of temperature and other stresses on fish eggs and larvae; determination of juvenile fish's swimming speeds; and pilot tests of changes in fish impingement given a variety of behavior-altering devices (light, sound, air bubbles, current vectors).

Killen, Ohio Power Plant Intake Pipe Made of Wedge Wire

Engineering tasks included feasibility studies and cost-estimating work on myriad CWIS options, including some tech-transfer systems made from materials like stainless steel, fine-mesh wedge-wire screens used for groundwater monitoring wells. At a minimum, utilities had to conduct entrainment and impingement studies at existing CWIS (baseline, predictive), or waterbody studies at proposed sites.

During the hey-day of the §316(b) decade (1974-1984), permitting decisions and the success of §316(b) demonstrations were a function of best professional judgment, benefit-cost comparisons, negotiations, hearing conclusions, and (sometimes) simply a directive by the utility itself to propose cooling towers without further evaluation to pave the way for permitting and getting on-line ASAP. Cooling towers have always been the BTA of choice to interveners, since they serve to recycle much of the cooling water, thus cutting the amounts that must be taken from the source waterbody. In practice, both the applicant's scopes of study, and success of the demonstration, often depended upon such factors as how large the plant was; whether it was fossil or nuclear-fueled; how much public controversy surrounded the plant; and even what State it was located within. Such issues led to suspension of §316(b) rules in 1977, and, in 1995, a consent agreement ordering the EPA to formulate new rules by the turn of the century.

Regulations Revamped

With some notable exceptions, for example the Hudson River power plants, §316(b) took a vacation from the mid-1980s through most of the '90s. Most of the existing power plants were permitted to continue to operate on the strength of §316(b) demonstrations performed during the mid-1970s. Periodically, they had to address issues such as the need for fish return systems, but it was not until the late '90s when agencies such as the NYSDEC, the CTDEP, and the EPA Region I began calling for updates on entrainment and impingement at all CWIS. This was effected through sampling and analysis require-ments made part-and-parcel of the NPDES Permit renewal process, no doubt in anticipation of final Phase II EPA rules now scheduled for publication in February, 2004. Those rules have the potential for making operation of once-through plants located on estuaries considerably more expensive.

EPA's Key Milestones Since 1995

- 1/98 – Information Collection Request (ICR) issued
- 6/98 – First public hearing (approach)
- 9/98 – Second hearing (cost-benefits, mitigation)
- 7/00 – Proposed Phase I Regs (new CWIS)
- 5/01 – "Panel of Experts" Conference
- 11/01 – Final Phase I Regs
- 2/02 – Proposed Phase II Regs (existing power plant CWIS)
- 5/03 – Meeting on technologies
- 2/04 – Final Phase II Regs due
- 11/04 – Proposed Phase III Regs due (other facilities with CWIS)
- 6/06 - Final Phase III Regs due

For both new and existing CWIS, EPA has defined sets of criteria for (a) determining whether your CWIS needs to comply with the regulation, and (b) if so, what kinds of design and performance specs it needs to meet. To view the details of these proposed regulations, as well as existing §316 (b) criteria, link to US EPA §316 (b) Regulations

Some Solutions…

Under the new rules, CWIS owners will have the option of simply complying with new performance criteria for minimizing entrainment and/or impingement, or demon- strating that (a) the impact of their CWIS is insignificant; (b) the costs of compliance far exceed the benefits; or (c) that greater benefits may be realized by implementing some "conservation measures", as opposed to installing expensive technologies like cooling towers.

As an example, in the mid-1990s, as part of an agreement to minimize impingement mortality and also create new ecological benefits commensurate with CWIS losses at its Salem, NJ plant, PSE&G began installing fish ladders in tidal creeks around Delaware Bay. This effort, which employed fish ladder designs that have been evolving ever since dams were first built to harness power and/or control floods (the first one being completed in 1798 at Turner's Falls, MA, on the Connecticut River)was begun in order to

A ladder constructed by PSE&G to enable river herrings to once again spawn in Delaware's Silver Lake.

restore alewife and blueback herring runs to some of the man spawning grounds that had been blocked by development dating back a century or so.

Fish Return System Sluice Devon, Connecticut Power Plant

Extensive wetlands were also re created up and down the estuary These and other mitigative offsets ar expected to be available to CWIS owners as they seek solutions to thei site-specific needs.

EEA's staff has experience ove many years conducting §316 (b) permit studies at numerous powe plants.

While the jury will still be out for a fev months as to how the states ma define their priorities and options wit respect to §316(b), owners of existin CWIS may want to revisit and updat those industry questionnaires of a fev years ago, and maybe start thinkin about their likely options, starting wit the strength of their "calculatio baselines". EEA would be happy t offer its services to help CWIS owner evaluate their profiles relative to thi important, re-emerging regulatory issue.For further information, contact Glenn Piehler, Ph.D. in EEA's Weehawken, New Jersey office at (201) 865-8444 or Roy Stoecker Ph.D. in EEA's Garden City Headquarters at (516) 746-4400.

01/26/04