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 of 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 that produce electricity in fossil- or nuclear-fueled power plants. The source of this “non-contact” cooling water has always been some adjacent 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.

The initial cause for concern centered on thermal pollution, since the cooling water was discharged back to the waterbody much hotter than when it was withdrawn. Then, people started noticing that large numbers of fish eggs and larvae could be taken into the CWIS with the
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 guidan documents during the mid-seventi to walk the applicant through t process. Much of the period guidance evolved around stud 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 approap velocities and avoiding dead-er intake locations.
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).

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 requirements 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.

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 demonstrating 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 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.

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

EEA’s staff has experience over many years conducting §316 (b) permit studies at numerous power plants. While the jury will still be out for a few months as to how the states may define their priorities and options with respect to §316(b), owners of existing CWIS may want to revisit and update those industry questionnaires of a few years ago, and maybe start thinking about their likely options, starting with the strength of their “calculation baselines”. EEA would be happy to offer its services to help CWIS owners evaluate their profiles relative to this 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.