Attachment

Framework for Considering Existing Hydroelectric Facility Technologies in Establishing Case-by-Case, BPJ §316(b) NPDES Permit Conditions

EPA generally expects that hydroelectric facilities' existing controls are technologies that can be determined to satisfy the CWA requirements to minimize entrainment and impingement mortality. EPA is also aware that many hydroelectric facilities are required to implement measures that reduce impacts of the dam, including the impacts to passage of aquatic life through the dam, as conditions of a license issued by the Federal Energy Regulatory Commission or a Biological Opinion issued by US Fish and Wildlife Service or the National Marine Fisheries Service. While these are not technologies employed at the CWIS, these measures minimize the passage of aquatic life past the intake structures inside the penstocks of the dam and thus minimize entrainment and impingement mortality.

EPA considers the following four factors to be "technologies" that could minimize adverse environmental impacts from the use of a CWIS at hydroelectric facilities. Under this framework, any of the four factors below, individually or in combination, may be used in a BPJ analysis to determine whether BTA requirements have been satisfied. In most cases, EPA expects existing documentation can be used to evaluate these factors. Some facilities may have technologies other than those identified below that may also address adverse environmental impacts at the CWIS and that may be used in a BPJ analysis.

Factors to consider in developing BTA on a BPJ basis for all hydroelectric facilities:

1) Efficiency of cooling water used for power generation
    - Reduced withdrawals of cooling water provide a commensurate reduction in impingement and entrainment, along with a corresponding reduced risk of impingement mortality. Reduced cooling water withdrawals are most commonly associated with closed cycle recirculating systems (e.g., cooling tower use), but reduced cooling water use through other means provides the same reduction in impingement and entrainment. Hydroelectric plants generally withdraw significantly lower volumes of cooling water for each megawatt generated than do steam electric generating plants, including those with closed cycle cooling.
    - Cooling water use by a hydroelectric plant is typically limited to cooling the turbine bearings, generator bearings, and gearboxes. Further, the cooling water for such uses is typically withdrawn from falling water that has already been screened for debris. A major functional service component of steam electric power plants is the use of steam as the prime mover of the turbine. This steam loop produces waste heat that must be removed from the power plant. This is markedly different than the electric power generation at hydroelectric facilities, which use falling water or river currents to spin a turbine. Hydroelectric facilities do not use a steam loop and do not generate the excessive waste heat associated with steam electric power plants. See Section 4.2 of the Technical Development Document for the Final Section 316(b) Existing Facilities Rule[1] (TDD) for more information.

[1] Footnote 1: Technical Development Document for the Final Section 316(b) Existing Facilities Rule EPA-821-R-14-002, May 2014, available at https://www.epa.gov/sites/production/files/2015-04/documents/cooling-water_phase-4_tdd_2014.pdf

- Based on the cooling water used per megawatt generated, hydroelectric facilities are more efficient than other steam electric generating plants. The TDD at Section 5 describes the median water efficiency (expressed as water use per watts generated) of steam electric plants with various types of cooling water systems. In particular, TDD Exhibit 5-41 shows the median efficiency for each type of cooling water system, with a variety of horizontal lines that represent various thresholds. For example, the top 10 percent (the most efficient) of steam electric power plants on a water use per megawatt generated basis are those with closed-cycle systems. These steam electric plants with closed-cycle cooling have a median water use efficiency of 460 megawatts (in MWh) per billion gallons per day (BGD) (i.e., the top horizontal line of TDD Exhibit 5-41). Under the CWA Section 316(b) existing facility rule, existing power plants with a closed-cycle recirculating cooling system are deemed to comply with the BTA requirements to minimize impingement and entrainment. See 40 CFR 125.94(c)(1). Informed by this analysis, a hydroelectric plant could demonstrate that its water use per megawatt generated is comparable to (or more efficient than) closed-cycle cooling.
- To demonstrate the level of efficiency at a hydroelectric plant, a permit applicant could provide a calculation of megawatts (in MWh) produced divided by the cooling water used BGD. This ratio of water use per megawatts generated, if comparable to or higher than the median ratio of existing steam electric plants with closed-cycle recirculating cooling systems (i.e. 460 MWh/BGD), would indicate that the hydroelectric plant has cooling water withdrawal efficiency comparable to or better than steam electric power plants with closed-cycle cooling. In such cases, consistent with the Existing Facilities Rule BPJ provisions in 125.90(b), the facility would be deemed to meet BTA requirements to minimize entrainment and impingement mortality.

2) Cooling water withdrawn relative to waterbody volume or flow
   - In previous rulemakings, EPA stated that using a low percentage of the waterbody flow or volume that is used for cooling could be a factor that informs the degree of potential entrainment. In the Regulations Addressing Cooling Water Intake Structures for New Facilities[2] New Facility Rule, EPA established "proportional-flow requirements" that were intended to provide protections in addition to those commensurate with closed cycle and velocity requirements. For rivers and streams, EPA found that,

     > *The 5 percent value for rivers and streams reflects an estimate that this would entrain approximately 5 percent of the river or stream's entrainable organisms and a policy judgment that a greater degree of entrainment reflects an inappropriately located facility.*[3]

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[2] See 66 FR 65255-65345, available at: https://www.federalregister.gov/documents/2001/12/18/01-28968/national-pollutant-discharge-elimination-system-regulations-addressing-cooling-water-intake

[3] See 66 FR page 65301.

In other words, a facility that uses 5 percent or less of the flow of a river or stream would be deemed to meet BTA requirements to minimize entrainment. Because cooling water withdrawn at hydroelectric facilities is typically a small fraction of the overall river flow (to account for flow through fish passage structures or over spillways), often less than 1%,[4] EPA expects such withdrawals will be almost always below 5%.

- Proportional flow requirements only address entrainment as most passive floating organisms that are addressed by this factor are not of impingeable size. Impingement rates might be affected by a reduced flow, but in this case, there is no water use reduction, merely an overall minimal withdrawal of water relative to the waterbody flow or volume so credit for impingement reductions would not generally be assumed.

Factors to consider in developing BTA on a BPJ basis for a subset of hydroelectric facilities:

3) Location of the intake structure
    - Hydroelectric facilities vary significantly in terms of design and configuration, especially when it comes to the pipes and structures that divert water for purposes of cooling. Generally, water diverted for cooling is primarily sourced from three locations within the hydroelectric facility: (1) the penstock – a closed conduit or pipe that conveys water from the reservoir to the turbine, (2) the turbine scroll case – a spiral-shaped steel structure distributing water flow through the wicket gates located just prior to the turbine, or (3) a water inlet port located on the face of the dam. There likely are additional locations or configurations, because each facility has a unique, location-specific design to take maximum advantage of the hydraulics of that location.
    - EPA identified that the location of the intake could be a factor that minimizes both impingement and entrainment. Location of the intake in areas with lower densities of impingeable or entrainable organisms will minimize the adverse impacts associated with the use of the CWIS.
    - Generally, dams are designed such that the location of the penstock openings on the dam face are at a depth with a lower density of organisms to reduce entrainment through the dam thus minimizing impacts from the operations of the turbine. As the CWIS is within the dam, there is a similar reduction in the density of organisms as compared to an intake on the face of the dam or in the waterbody itself.
    - As described above, some dams do have water inlet ports on the face of the dam or in the waterbody so this may not be applicable to all hydroelectric facilities. Even in

[4] See page 11 of comments from the National Hydropower Association and the Northwest Hydroelectric Association available at https://www.epa.gov/sites/production/files/2020-06/documents/r10-npdes-usace-lower-columbia-snake-river-hydroelectric-facilities-public-comments-2020.pdf

these cases, the permitting authority may determine that no further controls are necessary, based on BPJ, to meet BTA requirements to minimize entrainment.

4) Technologies at the facility
   - Design of the facility can be a factor that addresses impacts due to impingement. The permitting authority can consider the configuration of the facility as a whole, including the location of the CWIS, in determining whether there are technologies that are sufficient to minimize impingement and entrainment. For example, many of the hydroelectric facilities have some form of screen over the intake pipe; generally this was intended for debris protection, but it also provides a level of impingement control compared to open pipe. EPA considers organisms that would be retained on a certain mesh size to be "impinged" even if there is no comparable screen on the intake pipe and the organism may actually pass through the cooling system.
   - Most hydroelectric facility intakes rely upon a passive gravity feed that in some cases might lead to a lower intake velocity than a pumped system. Given that water is moving through the system to drive turbines, the velocity may be higher than would be experienced in normal flow velocity in a waterbody. This higher velocity results in a higher sweeping velocity past the opening of the intake thus minimizing the time in which an organism can be "impinged." Impinged organisms are often of a size that they have enough motility that when they sense a screen or the opening of the intake, they have an avoidance response and swim away. Combined with the sweeping velocity that carries the organism past the intake rapidly, this can minimize the actual impingement of organisms.

As described above, EPA generally expects that a hydroelectric facilities' existing controls are technologies that can be determined to satisfy the BTA requirement to minimize entrainment and impingement mortality. As also noted above, EPA expects that, in most cases, existing documentation may be used to evaluate these factors and that the selection and use of documentation and data for this purpose will be relatively straightforward.

Under this framework, any one of the four factors can demonstrate implementation of BTA. If a facility pursues a determination that BTA is satisfied through factor 4 (Technologies at the facility), permit writers should understand that, for many hydroelectric facilities, conducting impingement or entrainment sampling at the pipe or intake structure could be very difficult, or even unsafe. Likewise, for many facilities, it may be difficult to collect information regarding the velocity approaching the intake. EPA suggests that permit writers make use of existing data to the extent they are available, but generally does not expect permit writers to seek development of new information or additional studies (e.g., impingement and entrainment studies) to inform the evaluation of this factor.