Response to NYSDEC's CWA § 401 Water Quality Certification Notice of Denial

Prepared for Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC

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EXECUTIVE SUMMARY

Indian Point Energy Center (IPEC), owned by Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC (collectively, Entergy), is seeking a renewal of the operating licenses for Indian Point Nuclear Generating Units 2 and 3. A Joint Application for a federal Clean Water Act § 401 Water Quality Certificate was submitted to the New York State Department of Environmental Conservation (NYSDEC) as part of Entergy's federal license renewal for Indian Point Units 2 and 3. On April 2, 2010, the NYSDEC provided notice of its denial of Entergy's application (Notice).

In NYSDEC's Notice, several conclusions from the reports entitled Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration (Closed-Loop Conversion Report) and Evaluation of Alternative Intake Technologies at Indian Point Units 2 & 3 (Alternative Technologies Report) were misinterpreted or mischaracterized, producing NYSDEC conclusions that are not consistent with those presented in the Reports. This engineering response to the Notice does not represent an inclusive summary of the Closed-Loop Conversion Report or the Alternative Technologies Report, but rather addresses only the most significant engineering misconceptions identified in the Notice.

Specifically, the NYSDEC statements regarding the availability of closed-loop condenser cooling (CCC) and the state of cylindrical wedgewire (CWW) screen technology are not supported by the available information:

NYSDEC Statement: "*A closed-cycle cooling system is an 'available' alternative.*"

Engineering Response: Conversion to CCC is unproven and faces substantial site-specific challenges at IPEC.

- Conversion to CCC is unprecedented, with no available construction or operating experience.
- NYSDEC relies upon a Nuclear Regulatory Commission (NRC) closed-loop cooling determination made over 30 years ago for a different technology which is no longer applicable.
- Several significant site-specific conditions challenge the engineering feasibility of conversion, and are uncontested or unmentioned in NYSDEC's Notice.

NYSDEC Statement: "*CWW screens are not a reasonable alternative intake technology.*"

Engineering Response: CWW screens are a technically preferable, feasible and reasonable intake technology.

- Decades of successful operating experience for large-diameter Hudson River installations (including one sized with a 2mm screen slot width) demonstrate that CWW screens are a technically feasible technology.
- Installation of CWW screens at IPEC Units 2 and 3 would be significantly less intrusive to the existing facility and operations than a conversion to closed-loop cooling.
- Recent EPRI studies on CWW screens validate the design parameters selected for the proposed installation at Indian Point, and are unmentioned in NYSDEC's Notice.

Further, NYSDEC does not apply consistent criteria in its evaluation of each technology. Although neither the application of CCC nor CWW screen technology has occurred at an operating nuclear facility, NYSDEC nevertheless concludes that CCC is an "available" technology while rejecting CWW screens as a proven, "available" technology. However, CWW have been installed on the Hudson River at several facilities, including some in proximity to IPEC. Contrary to NYSDEC's position, the United States Environmental Protection Agency (EPA) specifically selected CWW screens as the most appropriate compliance technology for Indian Point Units 2 and 3. NYSDEC offers no technical support for its position with respect to CWW, only conclusory statements.

Based on design guidance in recent EPRI studies, the Alternative Technologies Report describes the design parameters for a conceptual CWW screen installation. The proposed installation would have significantly less impact on existing plant facilities and operation than conversion to closed-loop cooling. In summary, the certainty of engineering feasibility is far greater for the installation of CWW screens than for the conversion to CCC.

1 Introduction

Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC (collectively, Entergy), are jointly seeking a renewal of the operating licenses for Indian Point Energy Center (IPEC) Nuclear Generating Units 2 and 3 (Units 2 and 3 or the Stations) in Buchanan, New York. The operation of Indian Point Units 2 and 3 involves the withdrawal from, and discharge into, a navigable surface water of New York State, namely the Hudson River. Consequently, a Joint Application for a federal Clean Water Act § 401 Water Quality Certificate was submitted to the New York State Department of Environmental Conservation (NYSDEC) as part of Entergy's federal license renewal for Indian Point. On April 2, 2010, the NYSDEC provided notice of its denial of Entergy's application (Notice).

In NYSDEC's Notice, several conclusions from the Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration (Closed-Loop Conversion Report) [Ref. 5.2] and the Evaluation of Alternative Intake Technologies at Indian Point Units 2 & 3 (Alternative Technologies Report) [Ref. 5.3] were misinterpreted or mischaracterized, producing NYSDEC conclusions that are not consistent with those presented in the Reports. This engineering response to the Notice does not represent an inclusive summary of the Closed-Loop Conversion Report or the Alternative Technologies Report, but rather addresses only the most significant engineering misconceptions identified in the Notice. Specifically, the NYSDEC statements regarding the availability of closed-loop condenser cooling (CCC) and the state of cylindrical wedgewire (CWW) screen technology are not supported by the available information. The Notice concludes that conversion of Indian Point to a CCC system is the only available and technically feasible technology to minimize the adverse environmental impact of the continued operation of Indian Point Units 2 and 3; however, the Closed-Loop Conversion Report concludes that there are several site-specific conditions (none of which are noted in the Notice) that would challenge the engineering feasibility of CCC at Units 2 and 3. In making its conclusion, the NYSDEC also rejects CWW screens as an available and technically feasible technology. The NYSDEC conclusion regarding CWW screens is partly based on criteria that are not consistently applied in the NYSDEC evaluation of CCC.

The following sections summarize the specific NYSDEC's statements in the Notice that are not supported by the available information:

Section 2: Contrary to the NYSDEC statement that CCC is an "available" technology, conversion to CCC at an operating nuclear facility is unproven and represents several significant site-specific challenges.

Section 3: The NYSDEC rejects CWW screens as a proven, "available" alternative technology, despite extensive operating experience from successful installations and support from both the U.S. Environmental Protection Agency (EPA) and the Electric Power Research Institute (EPRI).

Section 4: The application of either CCC or CWW screens technology has not occurred at an operating nuclear facility; however, the NYSDEC inconsistently concludes that closed-loop cooling is an "available" technology while rejecting CWW screens as a proven, "available" technology.

2 Conversion of an Operating Nuclear Facility to Closed-Loop Cooling is Unproven

Issue 1 Unprecedented Nature of Closed-Loop Cooling Retrofit

2.1.1 NYSDEC Statement

On Pg. 14, Ln. 9, of the Notice, the NYSDEC states that *"a February 12, 2010, report entitled 'Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration' [] concluded conversion to a closed-cycle cooling system was a feasible, but not reasonable, alternative."*

Although NYSDEC summarizes the conclusion of the Closed-Loop Conversion Report with the statement that conversion would not be reasonable, the Notice does not address the specific engineering feasibility challenges which lead to, and support, this conclusion. One significant challenge is the uncertainty associated with an unprecedented and complex conversion to closed-cycle cooling at an operating nuclear facility. This and other concerns, unaddressed by NYSDEC in the Notice, could challenge the engineering feasibility of the project and led to the conclusion that engineering feasibility is not guaranteed, contrary to NYSDEC's statement. Given the absence of technical explanation in the Notice, Enercon cannot specifically address the basis of NYSDEC's conclusions.

2.1.2 No Nuclear Facility has been Retrofit with Closed-Loop Cooling

No nuclear power generating facility designed solely for once-through cooling has been converted to closed-loop cooling. Conversion of the condenser cooling system of an existing plant presents fundamental design problems that result in plant performance impacts or require redesign of the condenser. As detailed in the Closed-Loop Conversion Report, at Indian Point Unit 2 and 3, the expected performance impacts could not be mitigated by condenser modifications without the complete reconstruction of the turbine building. Due to the untried nature of this type of conversion and the intrusive plant modifications that would be required, the engineering feasibility of a closed-loop cooling retrofit at a nuclear facility cannot be guaranteed, contrary to NYSDEC's statement, and would likely encounter unforeseen challenges during design and operation. NYSDEC does not address this engineering feasibility concern in the Notice.

2.1.3 No Directly Comparable Cooling Tower Installations

As noted in the Closed-Loop Conversion Report summarized by NYSDEC, *"a single round hybrid cooling tower for each Unit was found to most closely meet each Unit's performance needs"* [Ref. 5.2, pg. 4]. No round hybrid towers have been retrofitted or installed at a U.S. nuclear facility. One round hybrid cooling tower has been constructed at a new nuclear electric-generating facility by Balcke-Dürr (now owned by SPX) in Europe. This tower, commissioned in 1988, provides cooling for a 1,300 MW nuclear power plant in Neckarwestheim, Germany, drawing make-up water from a freshwater source with a flow rate approximately equivalent to one IPEC Unit. The difference between Indian Point's brackish water make-up and the German nuclear power plant's freshwater make-up would require that the dry heat exchanger section within the Indian Point hybrid cooling tower be made from costly titanium, instead of relatively inexpensive and easier to manufacture carbon steel. Additionally, because the German cooling tower does not draw from a saltwater make-up source, it provides no experience with round hybrid cooling tower particulate material (PM) emissions. Expected PM emissions from operation of cooling towers at Units 2 and 3 would exceed the National Ambient Air Quality Standards for PM_{10} and $PM_{2.5}$ as evaluated in the TRC Cooling Tower Impact Analysis for the Entergy Indian Point Energy Center [Ref. 5.6], provided to NYSDEC and unaddressed by NYSDEC in its Notice.

Although the German tower provides valuable background information on the functionality of the round hybrid tower, it does not provide comparable installation or operating experience, as it was not constructed as a closed-loop retrofit and operates using make-up water suction from a freshwater source. Thus, the German tower is not a reasonable basis for an engineering feasibility determination for an IPEC conversion and no comparable towers exist at nuclear facilities. NYSDEC does not address this engineering feasibility concern in the Notice.

2.1.4 Untested Operation of Closed-Loop Cooling Retrofit

As noted in Section 2.1.2, absent any practical history of closed-loop cooling retrofits at nuclear facilities, engineering observations and conclusions regarding any such conversion are subject to unforeseen challenges during the detailed design phase and the subsequent implementation. Indian Point Units 2 and 3 were designed with defined sets of operating parameters, which would be altered by conversion to CCC. The effects of long term operation at new operating parameters are unknown.

Additionally, without operating experience gathered from plants operating under a closed-loop / cooling tower retrofitted condition, there are potential issues regarding degraded equipment reliability and plant safety conditions. The United States Nuclear Regulatory Commission (NRC) states that the "systematic evaluation of operating data can identify potential significant safety problems or their precursors" [Ref. 5.5]. Without the availability of operating experience for a plant retrofit with closed-loop cooling, Indian Point would operate without the assistance of this knowledge base, potentially under an unknown degraded safety condition.

These considerations were disregarded in NYSDEC's availability finding, and are unaddressed in the Notice.

Issue 2 <u>Original NRC Determination on Closed-Loop Cooling</u>

2.2.1 NYSDEC Statement

On Pg. 15, Ln. 11 of the Notice, NYSDEC states that *"More than 30 years ago, however, the NRC had already independently evaluated and selected a closed-cycle cooling system as the only appropriate technology for reducing the adverse environmental impact from Indian Point's CWISs. <u>See</u>…*

Taken together, all of these reports and documents have concluded that conversion from a once-through cooling system to a closed-cycle cooling system, while expensive and involving a potentially lengthy construction process, is nevertheless the only available and technically feasible technology for Units 2 and 3 to completely satisfy the BTA requirement of 6 NYCRR § 704.5 and, therefore, comply with this State water quality standard."

The reports referenced by NYSDEC, which were issued more than 30 years ago, do not provide a sufficient or current basis for concluding that conversion to a closed-loop cooling system is the "only available and technically feasible technology" to satisfy the BTA requirement. In the referenced reports, NRC evaluated installation of natural draft cooling towers, which are not currently considered a suitable technology for implementation at Indian Point. In addition and more recently, the EPA has selected CWW screens as the most appropriate technology for compliance at Indian Point Units 2 and 3 (Attachment 1, Section 2).

NYSDEC offers no technical rationale for its preference for a dated NRC finding (for a different CCC technology) over a current EPA determination (for CWW). Furthermore, the Notice fails to acknowledge or account for that current EPA determination and the extensive technical record supporting EPA's determination [Attachment 1, Section 2 and Ref. 5.8].

2.2.2 NRC Selected Natural Draft Cooling Towers in Original SEIS

On Pg. 4, Ln. 24 of the Notice, NYSDEC states that *"On the basis of the evaluation and analysis set forth in the NRC's Final Environmental Statements for Units 2 and 3, and after weighing the environmental, economic, technical, and other benefits against environmental costs and risks and considering available alternatives, the NRC concluded that the operating licenses for the facilities should be amended to authorize construction of natural draft cooling towers (i.e., a closed-cycle cooling system) at each Unit."*

The NRC's selection of natural draft towers would diminish certain negative impacts of cooling tower operation – parasitic power losses, increased tower reliability, and decreased maintenance costs – when compared to hybrid towers, which utilize mechanical fans. The only CCC configuration currently under consideration for Units 2 and 3, however, does not utilize natural draft towers. Natural draft cooling towers sized for CCC at Indian Point would likely be over 500 feet in height[1] and have a sizeable footprint. The large towers required would have a significant aesthetic impact on the existing facility and the surrounding area. In addition, existing facility equipment and components within a 500 ft radius (i.e., the fall zone) of the towers would require careful consideration to ensure that safety-related systems would not be impacted in the event of a tower collapse. Due to permitting obstacles associated with these aspects of natural draft towers, two round hybrid towers were selected as the most appropriate technology for IPEC. In comparison to natural draft towers, each round hybrid tower would be approx. 168 ft in height [Ref. 5.2]. The increased parasitic losses, reduced tower reliability, and increased maintenance costs

[1] Height estimate is based on typical natural draft cooling tower heights at comparable installations. For example, the natural draft cooling tower at Nine Mile Point Unit 2 in Oswego, NY, is approx. 530 ft in height and accommodates a flow rate of 580,000 gpm, which is significantly less than the flow rate required at Indian Point.

associated with hybrid tower operation would represent significant negative impacts of a conversion to CCC at Indian Point, which were not considered by the NRC.

The determination made by the NRC more than 30 years ago regarding the installation of natural draft cooling towers, not currently considered suitable for the Indian Point site, does not provide a reliable technical basis for the NYSDEC conclusion that closed-loop cooling is an "available" technology.

2.2.3 EPA Selected CWW Screens Technology in Phase II Rule

On Pg. 4, Ln. 29 of the Notice, the NYSDEC notes that *"Prior to the respective deadlines for installation of closed-cycle cooling at the Indian Point facilities, however, the NRC's authority to require the retrofit under federal nuclear licenses was superseded by comprehensive amendments to the federal Water Pollution Prevention and Control Act (a/k/a the Clean Water Act [CWA]) and creation of the National Pollutant Discharge Elimination System (NPDES) program."*

In the decades since the comprehensive amendments to the CWA noted by NYSDEC, the EPA has continued to evaluate closed-loop cooling and alternative technologies potentially available to minimize adverse environmental impact at facilities throughout the U.S., including Indian Point. Based on continuing evaluation of these technologies, EPA issued CWA regulations for existing power producing facilities in 2004 that explicitly do not recommend closed-loop cooling:

> EPA did not select a regulatory scheme based on the use of closed-cycle, recirculating cooling systems at existing facilities based on its generally high costs (due to conversions), the fact that other technologies approach the performance of this option, concerns for energy impacts due to retrofitting existing facilities, and other considerations. Although closed-cycle, recirculating cooling water systems serve as the basis for requirements applied to Phase I new facilities, for Phase II existing facilities, a national requirement to retrofit existing systems is not the most cost-effective approach and at many existing facilities, retrofits may be impossible or not economically practicable. [Ref. 5.7]

In fact, the 2004 EPA Phase II rule specifically selects CWW screens as the most appropriate compliance technology for Indian Point Units 2 and 3 [Ref. 5.7].

NYSDEC's Notice fails to acknowledge or account for that current EPA determination and the extensive technical record supporting EPA's determination [Attachment 1, Section 2 and Ref. 5.8].

Issue 3 <u>Intrusive Retrofit to Closed-Loop Cooling</u>

2.3.1 NYSDEC Statement

On Pg. 16, Ln. 38, the NYSDEC states that *"[the Closed-Loop Conversion Report] indicated that conversion from a once-through cooling system to a closed-cycle cooling system, while expensive and involving a potentially lengthy construction process, is* *nevertheless an available and technically feasible technology for Units 2 and 3 to satisfy the BTA requirement of 6 NYCRR § 704.5 and, thereby, comply with this State water quality standard."*

NYSDEC overstates the availability of a conversion to closed-loop cooling by neglecting to address the significant site-specific challenges to conversion discussed in the Closed-Loop Conversion Report. As noted by the NYSDEC, a conversion to closed-loop cooling would be expensive and require a lengthy construction process. However, NYSDEC fails to note that the estimated expense and duration of a conversion result from several complex site-specific conditions that each could challenge the engineering feasibility of the project. Such challenges include the extensive blasting operations required for the installation of cooling towers and circulating water piping, the substantial excavation required for tie-in construction in the heavily congested Riverfront area (i.e., the space between the intake structures and turbine-generator buildings of each Unit), the required relocation of the on-site Algonquin Gas Transmission pipelines, and the operational complexity and potential effects of long-term, de-rated operation at IPEC.

2.3.2 Extensive Blasting for Cooling Tower Construction and Tie-In

As discussed in Section 5 of the Closed-Loop Conversion Report, conversion of Units 2 and 3 to closed-loop cooling would require the excavation of approximately 2 million cubic yards of soil and inwood marble bedrock. Blast removal would be required to excavate large quantities of bedrock at the cooling tower locations and in the piping trenches outside of the Riverfront area. To avoid prolonged forced outages[2], blasting operations are proposed to occur while both Units are operating (i.e., on line). As stated in Precision Blasting Services' Report, Blasting Feasibility Study for Conversion of Indian Point Units 2 and 3 to a Closed-Loop Cooling Water Configuration [Ref. 5.2, Attachment 7], a thorough analysis of the impact of blasting vibration on specific Unit components and the relocated Algonquin pipelines would be required to finalize blasting procedures and conclusively establish the engineering feasibility of the project. This analysis would require testing of individual components to determine appropriate vibration limits. Each of these blasting considerations would be affected by the site-specific ground conditions, which would need to be determined by onsite ground calibration. The engineering feasibility concerns presented in the Precision Blasting Services Report, unmentioned in the Notice, are contrary to NYSDEC's conclusion that CCC availability has been established, which disregards the site-specific testing required for blast operations.

2.3.3 Relocation of Algonquin Gas Transmission Pipelines

As discussed in Section 4 of the Closed-Loop Conversion Report, a portion of the Unit 3 cooling tower site overlaps the existing right-of-way for the Algonquin Gas Transmission pipelines. In order to accommodate excavation and construction of a cooling tower for Unit 3, the existing pipelines would have to be relocated within the IPEC site, pursuant to the terms of the pipeline easement. Spectra Energy Transmission, LLC (Spectra), owner and

[2] Prolonged forced outages would result in significant power replacement costs and potential impacts to the reliability of the regional power supply.

operator of the Algonquin pipelines, has preliminarily evaluated the feasibility of the required relocation [Ref. 5.2, Attachment 6]. The feasibility of relocation is contingent upon Spectra's review of the blasting plan for excavation discussed in Section 2.3.2. In addition, the Algonquin pipeline system is one of the largest interstate pipelines in the United States and, as such, is regulated by the Federal Energy Regulatory Commission (FERC). Any relocation of the Algonquin pipeline would require the prior approval of the FERC. Thus, NYSDEC's conclusion that CCC availability has been established for Unit 3 disregards feasibility concerns presented in the Spectra analysis which are unmentioned in the Notice.

2.3.4 Substantial Excavation in Congested Riverfront Area

As discussed in Section 2 of the Closed-Loop Conversion Report, new circulating water piping would need to be routed through the Riverfront area. There are several underground utilities present in the Riverfront area, the most significant of which are the service water and existing circulating water supply piping and electrical duct banks. Furthermore, this area is commonly used for vehicular traffic and is part of the heavy load path (i.e., the road must withstand loads up to 300 tons per NUREG-0612 [Ref. 5.4]). Therefore, the supply and return piping would need to be buried to sufficient depth beneath the road elevation and backfilled to support the current traffic patterns and the resultant structural loads.

In addition, excavation in the Riverfront area would intersect groundwater contamination plumes containing tritium and strontium, with potential for soil contamination. Additional sampling and radiological testing would be required to determine the quantities and locations of contaminated soil, which may challenge the feasibility of excavation. Thus, NYSDEC's conclusion that CCC availability has been established disregards the excavation considerations presented in the Closed-Loop Conversion Report, which are unmentioned in the Notice.

2.3.5 Long-Term De-rated Operation of IPEC

As discussed in Section 3 of the Closed-Loop Conversion Report, Units 2 and 3 were designed for and currently utilize the consistently cold water from the Hudson River for operation. Specifically, the main steam condensers at both Units were designed to operate over the fixed range of circulating water inlet temperatures provided by the Hudson River. Deviation beyond this range, as well as intraday variations, adversely impacts plant performance and reliability. Conversion of Units 2 and 3 to closed-loop cooling would increase the circulating water inlet temperature to the main condensers. Due to the unprecedented nature of a conversion to closed-loop cooling at an operating nuclear facility, the impact of this circulating water temperature increase on plant systems, operation, and output is not precisely known. As noted in Section 2.1.4, no closed-loop cooling retrofit operating experience exists to provide guidance on potential degradation of facility equipment and operations nor potential impact to plant safety conditions.

Thus, NYSDEC's conclusion that CCC availability has been established disregards the de-rating and safety-related considerations presented in the Closed-Loop Conversion Report, which are unmentioned in the Notice.

3 Cylindrical Wedgewire Screens are a Reasonable Alternative Intake Technology

Issue 1 <u>CWW Screens are a Proven Technology</u>

3.1.1 NYSDEC Statement

On Pg. 18, Ln. 3, of the Notice, the NYSDEC states that *"The Department thoroughly reviewed the Alternative Technology Report and has determined that Entergy's proposal to use 2.0 mm cylindrical wedge-wire screens at Units 2 and 3 is not reasonable, primarily because it is still experimental in nature, is an unproven technology on the scale that would be required at Indian Point, is not based on scientifically supported facts, and would not result in entrainment reductions that are commensurate with those that could be obtained by a closed-cycle cooling system."*

NYSDEC mischaracterizes the current state of CWW screening technology, which is a proven technology with long-term installations and conversions on the Hudson River, including near IPEC; a high-capacity installation with a flow rate comparable to Indian Point Units 2 and 3; and scientific evaluations that favorably recommend CWW screens as an available and proven technology. CWW screen installations have operated effectively at various power generation facilities worldwide for decades.

In addition and contrary to NSYDEC's misimpression, the "scale" of the CWW screens design at Indian Point is not dissimilar to other installations. CWW screens have been used at a power plant (Oak Creek Power Plant) with a total flow rate comparable with the total flow rate of Units 2 and 3. Additionally, because CWW screens are designed to pass a certain amount of flow through a certain screening area, the design considered for Units 2 and 3 would not be a larger scale version of this proven technology, but would merely require a greater number of the same size screens that have been utilized elsewhere [Ref. 5.8]. For this reason, NYSDEC's concerns about scaling represent a misunderstanding of the technology and its application.

3.1.2 Historic Implementation of CWW Screens

CWW screens are widely used for various types of water intake systems, including large wastewater treatment facilities, desalination plants, HVAC systems, and cooling water intakes for power generating facilities. CWW screens have been successfully operating for over 30 years, and have been installed at thousands of installations worldwide, many installed as retrofits or conversions. Johnson Screens, a leading CWW screen manufacturer, has implemented hundreds of CWW screen installations in the United States since the late 1970s. Table 3-1 summarizes the design parameters for select CWW screen installations comparable to the proposed installation at Indian Point Units 2 and 3.

Although CWW screens remain the subject of ongoing testing and evaluations, primarily for biological benefits, the engineering feasibility of the technology is proven.

Table 3-1 Summary of CWW Screen Installations Comparable to Indian Point Units 2 and 3

Installation Location / Cooling Water Source Waterbody	Flow Rate [MGD]	# of Screens	Diameter [ft]	Slot Size [mm]
Indian Point Conceptual Design / Hudson River	2,419	96	6.0[1]	9.0
		144		2.0
Oak Creek Power Plant / Lake Michigan	2,246	24	8	~9.5
Charles Point Resource Recovery Facility / Hudson River	55	8	4.5	2.0
IBM Poughkeepsie Facility / Hudson River	172.8	2	4.5 – 5	~3.2

[1] Slot sizes other than 2.0 and 9.0 mm could require other CWW screen diameters.

3.1.3 Successful CWW Screen Operations in Hudson River

The Indian Point conceptual design is supported by over 20 years of successful operating experience of several CWW screen installations along the Hudson River, including the Charles Point Resource Recovery Facility and the IBM Poughkeepsie facility. Large-diameter CWW screens have been successfully utilized for 30 years at the IBM facility in Poughkeepsie, NY, approximately 30 miles upstream on the Hudson River from Indian Point. In addition, CWW screens have been successfully utilized at the Charles Point Resource Recovery Facility since 1986, located approximately ½ mile away from Indian Point.

As noted in the Alternative Technologies Report, the slot size used at Charles Point (i.e., 2.0 mm) is the smallest slot size considered for CWW screens installation at Indian Point Units 2 and 3. Historical operating experience from the Charles Point installation indicates no operational issues due to fouling at this slot size in the Hudson River.

3.1.4 High-Capacity CWW Screen Installations

On Pg. 21, Ln. 32, of the Notice, the NYSDEC states that *"The successful operation of CWW screens on a large fossil fuel steam electric facility in a dynamic deepwater oligotrophic ecosystem like Lake Michigan is not analogous to the Indian Point setting and does not in any way demonstrate that this technology would be technically feasible at, or garner the same protective effects on, a nuclear facility of similar size in the Hudson Rivers highly turbid, estuarine ecosystem."*

As discussed in the Alternative Technology Report, Oak Creek Power Plant in Milwaukee, WI, operates the largest installation of CWW screens. The Oak Creek CWW screen system, installed at the end of an offshore intake system situated approximately 6000-7000 ft from the shoreline, is located at a depth of approximately 43 ft. The average depth of the proposed IPEC CWW screen installation is approximately 50 ft [Ref. 5.3]. This minimal depth difference is not expected to impact performance. The offshore intake system uses twenty-four (24) 8-ft diameter CWW screens with a slot size of 0.375 inches (~9.5 mm) to filter a flow rate of 1,560,000 gpm (Attachment 1, Section 1). The total intake flow rate at Oak Creek is comparable to the total intake flow rate at Indian Point Units 2 and 3.

EPRI has identified three critical criteria for consideration in CWW screen design: (1) small screen slot size, (2) low through-slot velocity, and (3) a relatively high velocity ambient current cross-flow (sweeping flow) to carry organisms and debris around and away from the screen [Ref. 5.1]. Each of these design criteria would be better met by the design proposed by Indian Point than the Oak Creek installation. Although not finalized, the Indian Point CWW screen systems would be designed with lower approach velocities with a slot size equal to or less than that used at Oak Creek, and would be sited in a portion of the Hudson River with a higher cross-flow velocity than the Oak Creek installation (located deepwater in Lake Michigan). Beyond meeting the EPRI criteria, CWW screens at Indian Point would be designed with an AirBurst System (ABS) to provide active cleaning of the screens, a feature which could not be included at the Oak Creek installation due to its distance off-shore. The CWW installation at Oak Creek supports the Indian Point Conceptual design as it successfully operates under less favorable design conditions at a total flow rate comparable to Indian Point Units 2 and 3.

The scale of the CWW screen design at Indian Point is not dissimilar to other installations. Because CWW screens are designed to pass a certain amount of flow through a certain screening area, the design considered for Indian Point would not be a larger scale version of this proven technology, but would merely require a greater number of the same size screens that have been utilized elsewhere. The interaction between each screen would be modeled using computational fluid dynamics (CFD), similar to EPRI's CWW screen modeling discussed in Section 3.3.3, to develop a design that minimizes inter-screen interference. According to the EPA's, Technical Development Document for the Final Section 316(b) Phase II Existing Facilities Rule (TDD) [Ref. 5.8], *"EPA believes that cylindrical wedgewire screens can be successfully employed by large intake facilities under certain circumstances. Although many of the current installations of this technology have been at smaller-capacity facilities, EPA does not believe that the increased capacity demand of a large intake facility, in and of itself, is a barrier to deployment of this technology. Large water withdrawals can be accommodated by multiple screen assemblies in the source waterbody."*

NYSDEC's position on the availability of CWW does not address this information, and in fact contradicts this technical support for CWW without explanation.

3.1.5 Scientific Evaluations of CWW Screens

As noted by the NYSDEC on Pg. 20, Ln. 10, of the Notice, there is a *"wealth of available industry literature on [entrainment reduction observed with CWW screens]."* Such studies provide scientifically supported facts that guide the design and applications of CWW screen installations, such as the installation proposed at Indian Point Units 2 and 3. In addition, as discussed in Section 2.2.3, EPA selected CWW screens as the "most appropriate compliance technology." The EPA's evaluation of the use of CWW screens in the TDD included the 2003 study by EPRI, "Laboratory Evaluation of Wedgewire Screens for Protecting Early Life Stages of Fish at Cooling Water Intakes" [Ref. 5.1] (see Section 3.3.2 for further discussion), and a study conducted at the JH Campbell and the Eddystone Generating Facility.

NYSDEC's position on the availability of CWW screens does not address this information, and in fact contradicts this technical support for CWW screens without explanation.

Issue 2 <u>Installation of CWW Screens Comparatively Non-Intrusive</u>

3.2.1 NYSDEC Statement

On Pg. 19, Ln. 20 of the Notice, the NYSDEC states that *"The Alternative Technology Report states that '[t]here are no applications of cylindrical wedge-wire [CWW] screens at nuclear power facilities."*

Although it is true that there are no CWW screen installations at an operating nuclear power facility, the uncertainty of successful installation of CWW screens at Unit 2 and 3 is significantly less than that for conversion to closed-loop cooling. The type of fuel (e.g., coal, natural gas, nuclear fuel, etc.) used at each facility would not significantly impact the engineering feasibility of CWW screens. The CWW screen installations would interface solely with the existing intake structures which are designed based on required flow rate and environmental regulatory requirements, regardless of fuel type at a particular facility. In contrast, as discussed in Section 2, Issue 3, conversion of Indian Point Units 2 and 3 to closed-cycle cooling would be intrusive to Station operations and would have a significant impact on the long-term operation of the Stations.

NYSDEC's position on the availability of CWW screens, without explanation, does not address this information, which provides technical support showing that CWW screens are a reasonable alternative technology.

3.2.2 Interface with Existing Intake Structure

Per the conceptual design provided in the Alternative Technology Report, CWW screens would be installed into existing intake structures without requiring significant modification to the Station's operation or existing equipment. Construction activities at IPEC would be limited to the CWW screens installation in the riverbed in front of the plant and comparatively non-intrusive modifications to the existing intake structures. Installation of CWW screens would have no impact on other existing structures or equipment, and, more specifically, would not affect any nuclear safety-related systems.

NYSDEC's position on the availability of CWW screens does not address this information, without explanation, which provides technical support showing that CWW screens are a reasonable alternative technology.

3.2.3 Minimal Impact to Long-Term Operation of IPEC

As discussed in Section 2, Issue 3, conversion of Indian Point to closed-cycle cooling would be intrusive to Station operations and would have a significant impact on the long-term operation of Indian Point. Although, as discussed in the Alternative Technology Report, the construction of the CWW screen systems at Indian Point could require the Stations to operate at reduced levels of generating capacity, each Unit would return to full operational capacity after the completion of the construction. Because implementation of CWW screens would not require significant modification to the Station's operation or existing equipment, there would be minimal impact to the long-term operation of Indian Point Units 2 and 3 or any of its nuclear safety related systems.

NYSDEC's position on the availability of CWW screens, without explanation, does not address this information, which provides technical support showing that CWW screens are a reasonable alternative technology.

Issue 3 <u>Recent EPRI Studies</u>

3.3.1 NYSDEC Statement

On Pg. 20, Ln. 14 of the Notice, the NYSDEC states that *"EPRI, an energy industry research organization, has conducted both laboratory and field studies of CWW screens and concluded that, for CWW technology to be effective in reducing entrainment, CWW must be designed with the following: (1) sufficiently small screen slot size to physically block passage of the smallest lifestage to be protected; (2) low through-slot velocity; and (3) relatively high velocity ambient current cross-flow to carry organisms and debris around and away from the screen. 'Where all conditions are present, wedge-wire screens can reduce entrainment…' (EPRI 1998, Taft 2000)."*

3.3.2 EPRI 2003 Conclusions

As stated above, EPRI has conducted laboratory and field studies of CWW screens for a number of years, with several highly relevant reports published subsequent to the 1998 study cited in the Notice. In particular, a study conducted in 2003 by EPRI concluded:

> Our results supported many previous conclusions regarding biological and engineering factors, and their relationships with one another, that are important in minimizing entrainment and impingement rates associated with wedgewire screens. Cylindrical wedgewire screens should be designed using hydraulic and biological criteria that will minimize impacts to the lifestages and species that are targeted for protection. One approach to this goal would be to address each screen design parameter separately (e.g., minimize slot velocity and width, maximize approach velocity). However, a more prudent approach would be to consider the interaction between design parameters as they relate to the species and lifestages that will be susceptible to entrainment and impingement. For example, a slot width that excludes all sizes of fish and eggs that will be exposed to a screen may not be required if sweeping

> velocities are sufficiently high and slot velocities are sufficiently low that exposed organisms are carried away. [Ref. 5.1]

The design criteria for CWW screens at Indian Point closely follows EPRI guidance based on conceptual CWW screen arrays with low slot velocities located at a point in the Hudson River with high sweeping velocities. Overall, EPRI's conclusion supports the concept of avoidance and continues to demonstrate the need for current BTA assessments including the results of recent industry studies.

NYSDEC's position on the availability of CWW screens, without explanation, does not address this information, which provides technical support showing that CWW screens are a reasonable alternative technology.

3.3.3 EPRI CFD Modeling

In conjunction with laboratory testing, EPRI included computational fluid dynamics (CFD) modeling in its 2003 study [Ref. 5.1]. As noted by EPRI, "CFD modeling techniques enable scientists and engineers to study complex three-dimensional flow patterns using computer-generated models." Using CFD modeling EPRI validated its 2003 laboratory work, concluding:

> The CFD evaluation of the wedgewire screen was able to demonstrate that the bounded flume environment produced hydrodynamic conditions for the wedgewire screens that were comparable to what would be encountered in an unbounded field application. Subsequently, the results of the biological evaluation should be representative of those expected with larvae and eggs in the field that approach cylindrical screens near the centerline and pass close to the screen surface as they move downstream. [Ref. 5.1]

Additionally, by using CFD modeling, EPRI concluded that due to the release location the laboratory results represented a worst case scenario.

> The CFD analysis and ADV [Acoustic Doppler Velocimeter] measurements also indicate that the biological evaluation results represent a worst case scenario because larvae and eggs were released at a location that kept them in close contact with the screens (i.e., within several centimeters of the screen surface) where the influence of intake flow velocity and direction on aquatic organisms would be at its greatest. The potential for intake velocity and flow direction to affect passing organisms appears to dissipate quickly over a relative short distance from the screen surface (about 0.5 m). Therefore, risk to entrainment and impingement also probably decreases rapidly for larvae and eggs as distance from the screens increases. [Ref. 5.1]

Finally, EPRI concluded that "the data that were gathered during the biological and CFD evaluations of cylindrical wedgewire screens clearly demonstrate that this technology can effectively protect early lifestages of fish from entrainment and impingement when designed according to appropriate biological and hydraulic criteria." [Ref. 5.1]

NYSDEC's position on the availability of CWW screens, without explanation, does not address this information, which provides technical support showing that CWW screens are a reasonable alternative technology.

4 Contradictory NYSDEC Evaluations of Closed-Loop Cooling and CWW Screens

4.1.1 NYSDEC Statement

As discussed in Section 3, Issue 1 and Issue 2, NYSDEC rejects CWW screens as an available technology in part because there are no applications of CWW screens at nuclear facilities or at the scale that would be required at Indian Point. Additionally, on Pg. 19, Ln. 33 of the Notice, NYSDEC states "*the Alternative Technologies Report acknowledges that a "pilot" CWW screen project would be required in order to test, among other things, appropriate screen slot width sizes, different screen alloys, the number of screens to be used, potential screen configurations, screen monitoring requirements, and screen maintenance functions. Given this, the Department does not concur that wedge-wire screens are a proven, "available" technology for Units 2 and 3 to meet the BTA requirement in 6 NYCRR § 704.5.*

It is unreasonable for NYSDEC to conclude that a technology is not available because a "pilot" study would be required to optimize design for site-specific application. As detailed below, the uncertainties associated with CCC conversion are far more technically significant than those associated with CWW screens. Thus, the NYSDEC position on the availability of CWW screens at Indian Point is inconsistent with the NYSDEC position on the availability of a CCC retrofit at Indian Point.

4.1.2 Engineering Response

NYSDEC emphasizes the unprecedented nature of CWW screens at a nuclear power facility, while neglecting to address the fact that a conversion to CCC has never occurred at a nuclear facility (Section 2, Issue 1). As discussed in Section 2, Issue 3, conversion to CCC would require extensive blasting near the operating nuclear reactors, substantial excavation to accomplish intrusive tie-ins to the existing circulating water piping. In addition, operation with CCC would significantly increase the circulating water temperatures under warm ambient conditions, affecting existing Station equipment reliability, requiring additional operational support, and taxing the plant with parasitic and operational loads. In contrast, as discussed in Section 3, Issue 2, the installation of CWW screens would have a minimal and isolated impact to the existing intake structure and would be nearly transparent to plant operations.

NYSDEC also notes that a site-specific study is proposed at IPEC to determine appropriate CWW screen specifications and operating requirements, and cites this study as evidence of the "*experimental and unproven nature of using CWW screens*" at Indian Point Units 2 and 3. It is unreasonable for NYSDEC to conclude that a technology is not available because a "pilot" study would be required to optimize design for site-specific application. The "pilot" study would be designed to optimize the CWW screen system, not to determine its engineering feasibility, which was already determined in the Alternative Technologies Report [Ref 5.3]. Moreover, as noted in Section 2.3.2, a site-specific study would also be required to determine appropriate blasting limits for the conversion to closed-loop cooling.

Within the global timeline, in which CCC is not completed prior to 2029 [Ref. 5.2], conversion to CCC would require at least five more years of construction-related activities (not accounting for permitting considerations) compared to the construction activities required for the installation of CWW screens. The extended construction schedule is a measure of the additional complexity, and thus uncertainty, of conversion to CCC when compared to installation of CWW screens. Likewise, as noted in Section 2.1.4, the ability to operate IPEC in a CCC configuration is not guaranteed, and is subject to several significant construction and operability challenges. Construction challenges include authorization to blast adjacent to operating reactors, protracted schedule extensions, and site-specific vibration testing, which has not yet occurred and is required to allow blasting to move forward.

A summary of significant engineering feasibility considerations for a conversion to CCC and the installation of CWW screens is provided in Table 4-1. As shown, the certainty of engineering feasibility is far greater for the installation of CWW screens than for the conversion to closed-cycle cooling.

Table 4-1 Summary of Significant Engineering Feasibility Considerations for Each Technology

	Conversion to Closed-Loop Cooling	**Installation of CWW Screens**
Impact to Existing Facility	• Extensive on-site blasting • Substantial Riverfront excavation • Long-term de-rated operation • Intrusive circulating water tie-in • Peak operational efficiency power losses of 85.4 MWe • Parasitic losses of 72.2 MWe	• Relatively minor modification to Intake Structure • Minor parasitic losses from airburst system operation
Terrestrial Impact	• Excavation of 2 million cubic yards of soil and bedrock • Clearing of 40 acres of land • Salt deposition on surrounding vegetation	• None
Water Consumption	• 29.7 MGD River water loss from drift and evaporation	• None
Site-Specific Implementation Studies	• Vibration analysis on plant equipment • Ground vibration calibration testing • Soil sampling and radiological testing	• In-river screen testing
Operations and Maintenance	• Maintenance of numerous active components • Active control/monitoring of flow balance	• Periodic visual inspections by divers • Airburst operation
Outage Requirements	• 42 weeks per Unit, staggered	• No forced outage expected
Construction Schedule	• Approx. 97 months	• Approx. 36 months

5 References

5.1 Electric Power Research Institute. Laboratory Evaluation of Wedgewire Screens for Protecting Early Life Stages of Fish at Cooling Water Intakes. Technical Report 1005339. Palo Alto, CA. May 2003.

5.2 Enercon Services, Inc. Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration. 2010.

5.3 Enercon Services, Inc. Evaluation of Alternative Intake Technologies at Indian Point Units 2 & 3. 2010.

5.4 NUREG-0612, Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36, July 1980.

5.5 NUREG-0933, Resolution of Generic Safety Issues: Task I.E.: Analysis and Dissemination of Operating Experience, Rev. 3.

5.6 TRC Environmental Corporation. Cooling Tower Impact Analysis for the Entergy Indian Point Energy Center Westchester County, New York. Lyndhurst, NJ. September 2009.

5.7 United States Environmental Protection Agency. National Pollutant Discharge Elimination System - Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities. Federal Register, Volume 69, Number 131, pp. 41576-41693. Washington, DC. July 9, 2004.

5.8 United States Environmental Protection Agency. Technical Development Document for the Final Section 316(b) Phase II Existing Facilities Rule. Washington, DC. February 12, 2004.