

AGENCY OF NATURAL RESOURCES  
DEPARTMENT OF ENVIRONMENTAL CONSERVATION  
WATERSHED MANAGEMENT DIVISION  
ONE NATIONAL LIFE DRIVE, MAIN-2  
MONTPELIER, VT 05620-3522

FACT SHEET  
(March 2017)

**DRAFT NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT  
TO DISCHARGE TO WATERS OF THE UNITED STATES**

**PERMIT NO:** 3-1199  
**PIN:** NS75-0006  
**NPDES NO:** VT0000264

**NAME AND ADDRESS OF APPLICANT:**

Entergy Nuclear Vermont Yankee, LLC  
320 Governor Hunt Road  
Vernon, Vermont 05354

**NAME AND ADDRESS OF FACILITY WHERE DISCHARGE OCCURS:**

Vermont Yankee Nuclear Power Station  
320 Governor Hunt Road  
Vernon, Vermont 05354

**RECEIVING WATER:** Connecticut River

**CLASSIFICATION:** Class B. Class B waters are suitable for swimming and other forms of water-based recreation; irrigation of crops and other agricultural uses; good aesthetic value; aquatic biota and aquatic habitat; boating, fishing, and other recreational uses; public water source with filtration and disinfection or other required treatment.

I. Action, Type of Facility, and Discharge Location

The Vermont Agency of Natural Resources (hereafter referred to as “Agency”) received a renewal application for the permit to discharge into the designated receiving water from the above-named applicant on June 30, 2015. Entergy Nuclear Vermont Yankee, LLC (ENVY) is engaged in the operation of Vermont Yankee Nuclear Power Station (“Facility”), a nuclear electrical generating station that ceased power production in December 2014. The continuing discharge from the Facility to the Connecticut River is effluent from service water, boiler blowdown, and strainer/traveling screen backwash. The Agency has made a decision to renew the discharge permit.

## II. Description of Discharge

A quantitative description of the discharge in terms of significant effluent parameters is based on state and federal laws and regulations, the discharge permit application, and the recent self-monitoring data.

## III. Limitations and Conditions

The effluent limitations and the monitoring requirements may be found on the following pages of the permit:

Effluent Limitations:	Pages 2 – 4 of 18
Monitoring Requirements:	Pages 2 – 4 of 18

## IV. Facility Description and Background

ENVY owns and operates the Facility, a nuclear power station in Vernon, Vermont. The Facility is located on the west shore of Vernon Pool, an impoundment of the Connecticut River created by Vernon Dam. The dam and Vernon Station, a hydroelectric facility, are located approximately 0.75 miles downstream from the Facility. The Facility, which began operation in 1972, ceased all electric generating activities in December of 2014 and has now permanently defueled.

The cessation of electric generating activities has drastically changed the Facility's surface-water intake and use. The Facility's discharges were historically dominated by non-contact circulating water drawn from the river which resulted in a large heat load discharged into the river.

The Permittee's current National Pollutant Discharge Elimination System (NPDES) permit was issued in 2014 and regulates the Facility's withdrawal of water from the Vernon Pool in the Connecticut River for cooling purposes, as well as the discharge of pollutants to the Connecticut River. The current permit contains conditions regarding the water withdrawal from the Connecticut River by the Facility's Cooling Water Intake Structure (CWIS) as well as effluent limitations and conditions for each of the outfalls.

However, since the cessation of electricity generation activities, the discharge volume is less than 99% of historical discharge volume levels. The only remaining thermal load to the river is associated with the Service Water system, which primarily performs the necessary nuclear safety function of feeding the spent fuel pool cooling system, and because of radioactive decay, the thermal load will continue to decline at an exponential rate. Thus, this draft permit differs significantly from the current permit because it reflects the modified operations of the closed Facility.

The draft permit retains effluent limitations for the service water discharge (S/N 001); plant heating boiler blowdown (S/N 003); and strainer and traveling screen backwash water (S/N 009). All these discharges enter the Connecticut River via the discharge structure.

## V. Permit Basis and Explanation of Effluent Limitation Derivation

**Cooling Water Intake Structure:** The CWIS is located in a reinforced concrete bulkhead north of the Facility that extends downward about 30 feet below normal river surface elevation. The bulkhead was designed with two separate forebays to serve each the Circulating Water (CW) and Service Water (SW) systems. The entrance to each bay is protected from debris intrusion by fixed screens (bar racks). The screen openings are 3" by 3/8" rectangular vertical bars. A traveling water screen system provides basic fish and debris handling at the Facility's water intake structure. A traveling screen consists of 54 fiberglass basket elements that are chain-driven in a continuous loop. Each basket is formed from 0.080" diameter stainless steel wire cloth with 3/8" openings.

After shutdown of electricity generation activities at the Facility, the CW system (design intake flow of 518.4 million gallons per day (MGD)) was no longer necessary and there was a sharp reduction in the volume of water withdrawn from the river.

Historically, the SW system had a maximum design intake capacity of 17.3 MGD (four pumps each with a capacity of 4.3 MGD). The SW system has been modified for shutdown conditions, so that a single SW pump is supplying the safety-related needs of the Facility. Therefore, the total intake flow has been reduced from a maximum design intake capacity of 17.3 MGD to 4.3 MGD, only 21% of which will be used to cool the spent fuel storage pool. This reduced intake flow is calculated to have a maximum through-screen velocity of 0.04 fps. A second pump is maintained as a backup pump.

The Final 316(b) Rule for Existing Facilities (79 Fed. Reg. 48300-01, August 15, 2014) establishes standards for minimizing adverse impacts from CWISs. For existing facilities, the Final Rule applies to point sources (1) with a design intake flow (equal to the cumulative rated pump capacity) greater than 2 MGD *and* (2) that use 25% or more of the water withdrawn on an actual flow basis exclusively for cooling (40 C.F.R. § 125.91(a)). Actual flow is the average annual volume of water withdrawn over the past three years (40 C.F.R. § 125.92(a)). The design intake flow at the Facility is 4.3 MGD, but less than 25% of the actual intake flow at the Facility will be used exclusively for cooling (as stated above, only 21% of the 4.3 MGD will be used to cool the spent fuel storage pool). Therefore, the Final Rule does not apply, and the Facility is subject to a case-by-case determination of Best Technology Available (BTA) (40 C.F.R. § 125.90(b)).

Under 40 C.F.R. § 125.90(b) "Cooling water intake structures not subject to requirements under Sections 125.94 through 125.99 or subparts I or N of this part must meet requirements under section 316(b) of the CWA established by the Director on a case-by-case, best professional judgment basis."

**Entrainment:** With the cessation of electricity generation operations, the Facility has achieved BTA by effectively reducing its river water intake by 99%. On a case-by-case, best professional judgement basis, a reduction in intake volume greater than 99% compared to the design flow during operations is even greater than the flow reduction that would have been achieved had the Facility operated entirely in closed-cycle cooling (typically 97.5% for a freshwater facility, and likely less at this Facility because they would not have reduced the SW cooling needs) (79 Fed. Reg. 48333). In addition, cooling water is only anticipated to be needed until the spent fuel rods are ready for dry-cask, which is a limited period.

Impingement: Under the Final Rule at 40 C.F.R. § 125.94(c)(3), achieving an actual intake velocity of 0.5 fps is one option to comply with BTA standards for impingement mortality. Calculated through-screen velocity of the Facility under current operating conditions is less than 0.05 fps at maximum intake, well below the 0.5 fps limit.

**S/N 001 Service Water Discharge:** This discharge is currently made up of SW that is used to provide cooling water to plant equipment loads (such as the spent fuel pool, diesel generators, and various pumps and heat exchangers). As stated previously, the CW system – used to remove unused heat energy from the Main Condenser through ‘non-contact cooling’ – stopped operations when the Facility ceased power generation.

*Thermal Discharge: Modelling and Empirical Verification.* Section 3-01(B)(1) of the Vermont Water Quality Standards (VWQS) establishes temperature criteria for all state waters: the increase in the temperature of the receiving water, due to the discharge, may not exceed 1.0°F above ambient. Section 2-04(A) also establishes the conditions for the assimilation of these thermal wastes by allowing for a mixing zone to accommodate for temperature increases, provided that the mixing zone does not exceed 200 feet in length, and the temperature criteria are achieved at the end of this zone. The Permittee has required a variance from these criteria in past permits. As the thermal discharge will now meet the requirements of 3-01(B)(1)(b), the Permittee no longer requires a variance and shall meet the criteria set forth in the VWQS.

The heat loads being cooled with the SW system are generated by spent fuel stored in the spent fuel pool, and from various pumps and air conditioning units that remain in operation. The expected change in the temperature of the SW from the intake to the outfall ( $\Delta T_d$ ) can be calculated using the following equation:

$$\Delta T_d = \frac{Q}{\dot{m} \times C_p}$$

where,

$Q$  = total heat rejected to SWS  
=  $4.9 \times 10^6$  Btu/hr (December 2015)

$\dot{m}$  = mass flowrate of the SWS (one pump)  
= 3,000 gpm  
=  $1.5015 \times 10^6$  lb<sub>m</sub>/hr

$C_p$  = specific heat of water  
= 1.0 Btu/(lb<sub>m</sub>°F)

The change in SW temperature from intake to outfall is calculated to be 3.30°F. This value represents the upper limit of  $\Delta T_d$  during the term of the permit because of the exponential decline of the heat load due to radioactive decay. Specifically, the spent fuel pool – the major component of the total heat load – will decrease from 4.2 MBtu/hr in December 2015 to an estimated 2.0 MBtu/hr in December 2020.

Short-term temperature monitoring studies were conducted to evaluate the accuracy of this model. Temperature data collected from the intake and from the outfall showed that  $\Delta T_d$  consistently ranged from 2°F to 3°F, validating the calculated  $\Delta T_d$  of 3.3°F.

The Permittee provided further analyses to determine the effect of the discharged SW on the temperature of the river. The expected increase in river temperature above ambient at the end of the 200-foot mixing zone ( $\Delta T_x$ ) can be determined using a thermal mixing model developed by EPA:

$$\Delta T_x = \frac{\Delta T_d \times Q_d \times W}{Q_r \times \left( \pi \times D_y \times \frac{X}{\mu} \right)^{\frac{1}{2}}}$$

where,

$\Delta T_d$  = change in SW temperature from intake to outfall  
= 3.3°F, maximum

$Q_d$  = discharge volume  
= 3,000 gpm  
= 6.68 cfs

$W$  = width of river  
 $\approx$  1,500 ft, immediately downstream of discharge

$Q_r$  = river flow  
= 1,250 cfs, at minimum flow

$D_y$  = lateral dispersion coefficient  
=  $0.6 \times d \times u^* \pm 50\%$

$d$  = effective mixing depth for a thermal discharge  
 $\approx$  5 ft

$$u^* = (g \times d \times s)^{1/2}$$

$g$  = acceleration due to gravity  
= 32.2 ft/s<sup>2</sup>

$s$  = slope of the river  
 $\approx$  0.0001 ft/ft

$X$  = distance downstream from discharge  
= 200 ft

$\mu$  = river flow velocity  
= 0.0125 ft/ft, at minimum flow

The river temperature at the end of the 200-foot mixing zone is calculated to be 0.19°F higher than ambient river temperature, well beneath the VWQS limitation of 1°F. Recognizing that the actual lateral dispersion coefficient,  $D_y$ , could vary with river depth and flow, calculated  $\Delta T_x$  varied from 0.16°F to 0.27°F.

Short-term temperature monitoring studies were conducted to evaluate the accuracy of this model. Instream temperature monitoring confirmed that the effect of this thermal discharge on the temperature of the river at the edge of the 200-foot mixing zone was minimal: during time periods when solar insolation was low or absent, the temperature of the river at the end of the 200-foot mixing zone consistently measured 0.0 to 0.2°F above ambient river temperature.

The Permittee has contended that the effect of the Facility's thermal discharge on the temperature of the river cannot be accurately measured because of the confounding effects of temporally- and spatially-variable solar input on the temperature of the surface waters of the Vernon Pool. Given the verification of the models with field measurements, the Agency has concluded that, with the inclusion of a margin of safety, these models can be used to sufficiently ensure compliance. A margin of safety is necessary to account for the uncertainty between various model assumptions and the actual environment. A margin of safety of 20% reduces the allowable  $\Delta T_x$ , due to this discharge, from 1.0°F to 0.8°F. Using the thermal mixing model, it can thus be determined that the effluent may not exceed a  $\Delta T_d$  of 9.8°F. Because the Permittee indicated the use of thermistors with the accuracy of  $\pm 0.5$  °F, the proposed  $\Delta T_d$  permit limit is 9.3°F.

*pH.* The pH limitation remains at 6.5-8.5 Standard Units as specified in Section 3-01(B)(9) in the Vermont Water Quality Standards. This facility has demonstrated an excellent historical performance of compliance with the pH limitations set in the current permit. Daily monitoring has provided evidence of a pH level of the discharge at levels within the permit limitations. Thus, the monitoring schedule has been reduced from daily to weekly in the draft permit.

*Chemicals.* The SW system is treated four times per week to reduce biofouling of the Facility's piping; treatment consists of two hours with Bulab 8031 and one hour with Spectrus NX-1104. Oxidizing biocides are no longer used for treatment, and the monitoring requirement for residuals has been eliminated in the draft permit.

*Metals.* The draft permit maintains the monthly monitoring conditions for copper, iron, and zinc. The sampling site for metals analyses has been relocated to better isolate the source of any metals in the discharge: the samples shall be collected at the intake structure and at the outfall. The metals shall be analyzed for both total and dissolved phases to determine the source of any elevated metal concentrations.

**S/N 003 Plant Heating Boiler Blowdown:** Plant heating boilers discharge relatively small volumes of blowdown once or twice a day during the heating season. The boilers are treated daily with an oxygen scavenger and pH control agent (Cortrol OS7700). This wastestream discharges through the main outlet structure. The permitted flow of 0.0010 MGD and requirement for estimating the daily discharge are unchanged from the current permit.

**S/N 004 Water Filter Carbon Filter Backwash:** This discharge was eliminated and has been removed from the draft permit.

**S/N 006 Demineralized Trailer Rinse Down Water:** This discharge was eliminated and has been removed from the draft permit.

**S/N 009 Strainer and Traveling Screen Backwash:** River water is utilized to backwash the service water traveling screens in the cooling water intake structure. Backwashing now occurs only once per shift, and the flow limit has been reduced from 0.050 MGD to 0.0020 MGD in the draft permit. Monitoring is required when backwashing occurs. A small amount of penetrant/biodispersant may be in the discharge as a result of use to reduce biofouling of the Facility's piping. Any debris collected as a result of the backwashing is disposed of according to state and federal regulations (i.e. not discharged back into the river).

**Other Provisions:**

*Approved Chemicals.* All chemicals have been reviewed by the Agency for negative environmental effects. The need for several chemicals has been eliminated with the shutdown of electricity generation activities at the Facility, and have been removed from the draft permit. Bulab 8006 was replaced by Bulab 8031, a penetrant/biodispersant for use in minimizing and removing fouling within the service water systems; maximum concentration remains 20 ppm.

*Environmental Monitoring Studies.* When the Facility was operating as an electric generating station, the Permittee was granted a variance from the temperature criteria in the VWQS. To ensure the protection and propagation of a balanced and indigenous population of shellfish, fish, and other wildlife, including their respective habitats, under the conditions allowed by the variance, previous permits included a biological monitoring program, and additional objective specific studies. The Permittee no longer requires a variance from the VWQS, eliminating the necessity of such a monitoring program.

VI. Procedures for Formulation of Final Determinations

The public comment period for receiving comments on this draft permit is from **March 14 through April 14, 2017** during which time interested persons may submit their written views on the draft permit. All written comments received by 4:30 PM on **April 14, 2017** will be retained by the Agency and considered in the formulation of the final determination to issue, deny, or modify the draft permit. The period of comment may be extended at the discretion of the Agency.

Written comments should be sent to:

Agency of Natural Resources  
Department of Environmental Conservation  
Watershed Management Division  
One National Life Drive, Main Building, 2<sup>nd</sup> Floor  
Montpelier, VT 05620-3522

Comments may also be faxed to 802-828-1544 or submitted by e-mail to [ANR.WSMDWastewaterComments@vermont.gov](mailto:ANR.WSMDWastewaterComments@vermont.gov). Questions may also be directed to the Wastewater Program staff by calling (802) 490-6118.

Any interested person or groups of persons may request a public hearing with respect to this draft permit. Any such request for a public hearing shall be filed within the public comment period described above and shall indicate the interest of the party filing such request and the reasons why a hearing is warranted.

The Agency will hold a hearing if there is significant public interest in holding such a hearing. Any public hearing brought in response to such a request will be held in the geographical area of the proposed discharge or other appropriate area, at the discretion of the Agency and may, as appropriate, consider related groups of draft permits. Any person may submit oral or written statements and data concerning the draft permit at the public hearing. The Agency may establish reasonable limits on the time allowed for oral statements and may require the submission of statements in writing. All statements, comments, and data presented at the public hearing will be retained by the Agency and considered in the formulation of the final determination to issue, deny, or modify the draft permit.

The complete application, draft permit, and other information are on file and may be inspected by appointment on the 2<sup>nd</sup> floor of the Main Building at One National Life Drive, Montpelier, Vermont. Copies may be obtained by calling 802-828-1535 from 7:45 AM to 4:30 PM Monday through Friday, and will be made at a cost based upon the current Secretary of State Official Fee Schedule for Copying Public Records. The draft permit and fact sheet may also be viewed on the Watershed Management Division's website at <http://www.watershedmanagement.vt.gov/>.