



Memorandum

Friday, March 28, 2014

TO: Lynn DeWald, Vermont Yankee
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FROM: Mark Hutchins, Senior Water Resources Engineer
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SUBJECT: Proposed Draft NPDES permit for Vermont Yankee

INTRODUCTION

Normandeau Associates was asked by Vermont Yankee (VY) to assist with an evaluation of the proposed conditions in a draft renewed NPDES permit, proposed to be issued soon by the Vermont Agency of Natural Resources (VANR). Our technical review of the permit conditions proposed in this draft permit is provided below.

PERMIT CONDITIONS

A summary of special condition changes and analysis of significance follows:

- **SECTION I(A)(7)(a)** proposes to change the “winter” period from the current October 15 through May 15 timeframe to November 16 through March 31. It would further eliminate the use of Equation 1.1 for determination of permit compliance, relying instead on measured temperature at Station 3. As with the current permit, measured temperature at Station 3 would be constrained to not exceed 65°F at any time during this time period, the rate of change at Station 3 is not to exceed 5°F per hour, and the temperature at Station 3 may not increase by more than 13.4°F above ambient.

ANALYSIS: Although one might question the biological rationale for reducing the historical “winter” period to November 16 through March 31, in reality, the proposed permit changes would result in minimal impact to VY’s operations during this new time period. A review of the 2009-2013 monitoring data

showed that measured hourly average temperature at Station 3 never approached 65°F (and this measured temperature reflects the addition of heat from VY's cooling water discharge) during the newly defined "winter" period and under VY's existing operational modes. Thus, no change in operations would be necessary, even if the compliance equation was eliminated. However, in the absence of Equation 1.1, the term "ambient" would need to be defined as to the temperature at Station 7.

The more important observation, however, is that there is no biological basis for eliminating Equation 1.1 or for modifying the term of the winter period. This conclusion is supported by the findings of Vermont Yankee's §316(a) Demonstration Report (Normandeau 2004), which established that Equation 1.1 and the summer (May 16 through October 14) thermal limits based on this equation were protective not only of all life stages of American shad, but also protective of all life stages of other migratory and resident fish species that use Vernon Pool and Turners Pool as habitat for part or all of their life cycles. Additionally, VY's earlier §316(a) Demonstration (Binkerd et al. 1978) established that the use of Equation 1.1 as applied to the winter (October 15 through May 15) period thermal limits is compliant with §316(a) of the Federal Clean Water Act. Vermont Yankee's thermal limits specified in NPDES Permit No. 3-1199 issued March 30, 2006 were affirmed by the Vermont Environmental Court during proceedings from 2006 through 2009 and in a final Decision by the Vermont Supreme Court dated December 18, 2009. No new biological data has been provided that contradicts these findings, including during the Vermont Public Service Board hearings in 2013.

- **SECTION I(A)(7)(b)** proposes to change the "spring" period from the current May 16 through June 15 to April 1 through June 30. Further, it eliminates the use of Equation 1.1 for determining permit compliance, relying instead on the measured Station 7 temperature to determine the allowable delta T and measured Station 3 temperature to determine compliance. This section also adds an additional condition that would require VY to operate in closed cycle "when the maximum daily temperature in the Vernon Fish Ladder exceeds 70°F for XX consecutive hours and there have been shad passage observed through the Turners Falls Gatehouse Ladder."

ANALYSIS: Equation 1.1 calculates the delta T increase at Station 3 that would result from the VY cooling water discharge, based on the heat load from the discharge and the reported river flow through Vernon Dam. Eliminating the compliance equation and replacing it with a measured compliance based solely on the downstream temperature at Station 3 seems reasonable on the surface.

However, it would, in fact, be virtually impossible to operate the VY cooling water system in any mode but closed cycle, as described below.

Under the current permit (and permits issued by VANR that have regulated the VY thermal discharge for decades), the increase in river temperature above ambient is determined by a mass-balance calculation. As with all mass-balance calculations when applied to riverine situations, the equations are derived to “balance” the combination of upstream river flow and temperature and discharge flow and temperature with a calculated downstream flow and temperature. Ambient conditions always are determined by the upstream temperature, and compliance is generally determined by monitoring temperature and volume of the plant discharge. Depending on the specific discharge and receiving water, downstream monitoring may also be required. In our experience with other facilities, downstream monitoring is seldom used as a measure of compliance, primarily because complex hydrology and external temperature influences make it virtually impossible to know exactly where to monitor and how to sort out the various other factors (solar radiation, flow regulation, impoundment ponding during times of minimum generation, etc.) that influence downstream ambient water temperature.

In the case of VY, a very similar, well-reasoned permitting approach has previously been taken by the VANR. The compliance equation (Equation 1.1) is simply a mass-balance equation that determines the maximum amount of heat that can be discharged without exceeding a seasonally-variable, allowable delta T.

As with most mass-balance equations, the allowable delta T at VY historically has been determined from the upstream measured temperature, which in this case is Station 7. Thus, the “ambient” temperature relative to existing operations is Station 7, which is consistent with the typical permitting approach used for thermal discharges. If the compliance equation can no longer be used to demonstrate compliance, then “ambient” becomes undefined in this permit section. If the intent of the proposed permit change is for Station 7 to remain the measure of “ambient” temperature, but to have compliance measured at Station 3, the permit should make that clear. However, we know from years of data collection and ASA’s modeling in support of the 2004 §316(a) demonstration that Station 3 water temperature is influenced strongly by atmospheric conditions (i.e., air temperature, solar insolation, runoff events, etc.) acting on the 4.9 mile-long reach of the Connecticut River between Station 7 and Station 3, and especially during periods of flow cycling for hydro-power generation. These influences are highly complex and cannot be forecast by VY operators with

sufficient accuracy to meet permit compliance demonstration requirements. In practical terms, these hydrodynamic and atmospheric complexities often result in temperatures at Station 3 that are 3, 4, or even more °F higher than at Station 7, much of which cannot be explained by the VY discharge.

A second complication of making measured Station 3 water temperature the demonstration of compliance is that the influence of the VY cooling water discharge on Station 3 temperature reflects the VY discharge that occurred 2 to 6 or even more hours prior to the time of measurement. To successfully determine how much heat could be discharged at time X would require VY to know what the “ambient” temperature would be at Station 3 at time X + 6 hours (or X + 2 or X + 8, depending primarily on river flow, but also at times on flow management at Vernon Dam). Considering that much of the time during this proposed “spring” period VY would be operating under a maximum permit delta T of 2°F, the factors discussed above strongly suggest that VY would have little choice but to operate conservatively under this proposed permit revision, which would likely mean closed cycle operation.

Additionally, the proposed 70°F maximum temperature criterion for the Vernon Fish Ladder is not grounded in biology and therefore places an unjustified restriction on VY. However, since the proposed permit terms equate to closed cycle cooling operations (likely for the entire “spring” period of April 1 to June 30), this criterion makes little practical difference anyway. As a technical note, this condition contains confusing wording in that it refers to “maximum daily temperature” exceeding “70°F for XX consecutive hours.” What is maximum daily temperature when used in an hourly context? Similarly, the permit condition refers to “shad passage observed through the Turners Falls Gatehouse Ladder,” but it does not provide any context as to when that observation was made or how it will be relayed to VY operations. Additionally, there is no guidance for determining when the plant could come out of closed cycle. Should one conclude that whenever the fishway temperature did not exceed 70°F for “XX” consecutive hours, open or hybrid cycle would be allowed?

More importantly, and as noted previously, there is no demonstrated biological basis for eliminating Equation 1.1, for modifying the “spring” period, or for establishing a maximum daily temperature limit of 70°F as measured in the Vernon Fish Ladder during the period from April 1 through June 30 of each year and when American shad are available in Turners Pool. The thermal tolerance of adult American shad is reported in peer reviewed literature as optimum for growth between 50°F and 88°F, the avoidance temperature is 86°F, the upper incipient lethal temperature (UILT) is 90.5°F, and the maximum tolerance is 95°F

(Normandeau 2004). In the most recent sworn testimony before the PSB, VANR (Cox) agreed that 57.2°F to 76.1°F is the optimum temperature for adult shad spawning, the maximum range of spawning is 46.4°F to 78.8°F, the avoidance temperature is 86°F, and the UILT is 95°F. Thus, there is general agreement among the primary literature, the §316(a) Demonstration Report, and VANR on the thermal tolerances of adult American shad, yet the proposed permit condition uses a temperature (70°F) that is inconsistent with these thermal tolerances.

Specifically, with respect to American shad in the Connecticut River, the measured hourly average water temperatures in the Vernon Fish Ladder, in lower Vernon Pool, and in upper Turners Falls Pool during the recent and historic May 15 through June 30 annual periods of upstream passage typically reflect optimum or near optimum temperatures. The measured river water temperatures observed in the Vernon Fish Ladder do not exceed the thermal tolerance of adult American shad during the upstream spawning migration or post-spawning emigration, and in fact are near optimum under the present thermal regulations. Historically (1991 through 2012), only 5% of the adult American shad migrate upstream through the Vernon Fish Ladder annually before measured water temperatures were 53°F; the median (50%) of the adult shad run has passed upstream at about 68°F, and by 74°F, 95% of the run has migrated upstream. A measured water temperature of 70°F represents the Vernon Fish Ladder water temperature at which about 69% of the adult shad run has passed upstream on average among all years 1991 through 2012. In 2012, the most recent year with hourly shad count data available after structural repairs were made to the Vernon Fish Ladder, of the 10,922 adult American shad that migrated upstream into Vernon Pool to spawn, a cumulative 5% had migrated by about 60°F, the median (50%) adult shad run had passed upstream at about 68.5°F, 95% of the run has migrated upstream by 74°F, and 66% of the run had passed upstream when the measured water temperature reached 70°F. Therefore, 70°F appears to be an arbitrary thermal limit with no scientific basis, unrelated to the published literature, VANR's own PSB testimony, or the actual observed behavior of adult American shad using the Vernon Fish Ladder to pass upstream into Vernon Pool to spawn.

- **SECTION I(A)(7)(c)** proposes to limit the “summer” period to the month of July only (July 1 through July 31). It further eliminates the use of Equation 1.1 for demonstration permit compliance and relies instead on measured Station 3.
- **ANALYSIS:** As discussed above, it would be impossible for VY to maintain permit compliance without operating in closed cycle during this time period. It

is assumed, although not definitively known, that measured Station 7 would provide the “ambient” temperature to which measured Station 3 would be compared.

As noted and discussed previously, there is no demonstrated biological basis for eliminating Equation 1.1 or for modifying the term of the “summer” period.

- **SECTION I(A)(7)(d)** proposes to add a new seasonal period from August 1 through November 15. Temperature compliance would be determined by measured Station 3 temperature, presumably compared to Station 7 temperature to determine the measured increase above ambient temperature. The allowable delta Ts would be the same as are applied to the “spring” period.
- **ANALYSIS:** As noted above, reliance on measured differences between Stations 3 and 7 to determine compliance would require VY to operate in closed cycle for much, if not all, of this period.

As noted and discussed previously, there is no demonstrated biological basis for creating a new “late summer/fall” compliance period or for imposing the more restrictive “spring” delta T requirements during the time period.

CONCLUSIONS AND RECOMMENDATIONS

Elimination of the compliance equation and substituting measured Station 3 water temperature as the method for determining permit compliance effectively eliminates the possibility of VY’s operating in any mode but closed cycle during the spring, summer and fall. Although VANR stated that this draft permit presents a compromise position from requiring closed cycle operation, it does not due to the factors cited above. Moreover, there is no evidence of historic or ongoing biological harm resulting from the historic or current VY discharge that would support these proposed permit modifications, including the proposed seasonal changes. It is, therefore, our recommendation that the proposed permit conditions be deleted and the terms of the existing permit remain in effect until Vermont Yankee ceases operations in December 2014.

OTHER PERMIT CONDITIONS

- **SECTION I.8** specifies an annual report will be delivered to VANR by 31 May 2013. This is the same due date as in the previous permit. However, for each

field sampling program specified in Section IV (hourly river flow, temperature, water quality, macroinvertebrates, larval fish, fish, anadromous fish, and fish impingement), there is a new specification requesting Excel data files of the annual data and delivery of these data files annually by a date to be specified, or earlier when requested by VANR in writing.

- **ANALYSIS:** Final Excel data files will be delivered within a month (30 days) after the annual report is accepted as final by VANR. Delivery of these data during an ongoing sampling season would be a costly and unreasonable effort. For example, the larval fish samples are collected weekly during May through July 15, but are not processed in the lab until the winter months. It would be costly and inefficient to process them during or shortly after the samples are collected. Furthermore, data files are not final until they have been subjected to both QC and analysis as is done when preparing the annual report.
- **SECTION IV, Fish** specifies a new requirement that scale samples will be taken from American shad caught during general electrofishing.
- **ANALYSIS:** Scale samples will be taken from all adult American shad caught, not from all American shad, because length alone will distinguish the young of the year (age 0) from the adults.
- **SECTION IV, Fish** specifies an increase in the field general electrofishing sampling effort that is more than double the previous programs.
- **ANALYSIS:** The sampling requirements of the NPDES permit issued March 30, 2006 have been specified and approved by the EAC and considered appropriate and sufficient for use in long-term trend analysis and in the successful §316(a) Demonstration Report (Normandeau 2004). We request justification for this increased effort.
- **SECTION IV, Fish Impingement** specifies impingement sampling of the traveling screen backwash be expanded to weekly, 52 weeks per year, instead of 23 weeks per year.
- **ANALYSIS:** The sampling requirements of the NPDES permit issued March 30, 2006 have been specified and approved by the EAC and considered appropriate and sufficient for use in long-term trend analysis and in the successful §316(a) Demonstration Report (Normandeau 2004). We request justification for this increased effort.

- **SECTION IV, Trend Analysis** is specified for fish but not for macro-invertebrates.
- **ANALYSIS:** Please confirm that the requirement for macroinvertebrate trends analysis has been deleted from the permit conditions.