September 6, 1976

Docket No.: 50-271

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TBAbernathy
JRBuchanan
BHarless
WPasciak

Yankee Atomic Electric Company
ATTN: Mr. Robert H. Groce
Licensing Engineer
20 Turnpike Road
Westboro, Massachusetts 01581

Gentlemen:

The Commission has issued the enclosed Amendment No. 28 to Facility Operating License No. DPR-28 for the Vermont Yankee Nuclear Power Station. The amendment consists of changes to the Technical Specifications (Appendix B) in response to your application dated July 8, 1976 and staff discussions.

This amendment modifies the limiting conditions of operation and surveillance requirements related to the discharge of condenser cooling during the period September 6, 1976, through May 31, 1977, to permit the acquisition of special environmental information related to the effects of open cycle cooling.

These modifications to the limiting conditions for operation and surveillance requirements of the Appendix B Technical Specifications do not involve significant new safety information of a type not considered by a previous Commission safety review of the facility. They do not involve a significant increase in the probability or consequences of an accident, do not involve a significant decrease in a safety margin, and therefore do not involve a significant hazards consideration. We have also concluded that there is reasonable assurance that the health and safety of the public will not be endangered by this action.

No legal objection as amended

Copies of the Environmental Impact Appraisal and the Federal Register Notice are also enclosed.

Sincerely,

Original Signed by

Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors

Enclosures:
1. Amendment No. 28
2. Environmental Impact Appraisal
3. Federal Register Notice

cc w/enclosures: See next page

B. GRIMES

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cc w/enclosure(s):
Mr. James E. Griffin, President
Vermont Yankee Nuclear Power Corporation
77 Grove Street
Rutland, Veront 05701

Mr. Donald E. Vandenburgh, Vice President
Vermont Yankee Nuclear Power Corporation
Turnpike Road, Route 9
Westboro, Massachusetts 01581

John A. Ritsher, Esquire
Ropes & Gray
225 Franklin Street
Boston, Massachusetts 02110

Gregor I. McGregor, Esquire
Assistant Attorney General
Department of the Attorney General
State House, Room 370
Boston, Massachusetts 02133

Richard E. Ayres, Esquire
Natural Resources Defense Council
917 - 15th Street, N. W.
Washington, D. C. 20005

Honorable M. Jerome Diamond
Attorney General
State of Vermont
109 State Street
Pavilion Office Building
Montpelier, Vermont 05602

John A. Calhoun
Assistant Attorney General
State of Vermont
109 State Street
Pavilion Office Building
Montpelier, Vermont 05602

Anthony Z. Roisman, Esquire
Berlin, Roisman and Kessler
1712 N Street, N. W.
Washington, D. C. 20036

Brooks Memorial Library
224 Main Street
Brattleboro, Vermont 05301

John R. Stanton, Director
Radiation Control Agency
Hazen Drive
Concord, New Hampshire 03301

John W. Stevens
Conservation Society of
Southern Vermont
P. O. Box 256
Townshend, Vermont 05353

Mr. David M. Scott
Radiation Health Engineer
Agency of Human Services
Division of Occupational Health
P. O. Box 607
Barre, Vermont 05641

New England Coalition on
Nuclear Pollution
Hill and Dale Farm
West Hill - Faraway Road
Putney, Vermont 05346

Mr. Raymond H. Puffer
Chairman
Board of Selectman
Vernon, Vermont 05354

cc w/enclosures and copy of
VY's filing dtd.: 7/8/76
Public Service Board
State of Vermont
120 State Street
Montpelier, Vermont 05602

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

VERMONT YANKEE NUCLEAR POWER CORPORATION

DOCKET NO. 50-271

VERMONT YANKEE NUCLEAR POWER STATION

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 28
License No. DPR-28

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Vermont Yankee Nuclear Power Corporation (the licensee) dated July 8, 1976, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment.

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Robert W. Reid

Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors

Attachment:
Changes to the Technical
Specifications

Date of Issuance: September 6, 1976

ATTACHMENT TO LICENSE AMENDMENT NO. 28

FACILITY OPERATING LICENSE NO. DPR-28

DOCKET NO. 50-271

Revise Appendix B Technical Specifications as follows:

Remove Pages	Insert Pages
2	2 & 2a
8	8
	24 & 25 (Table 2.2-3)

Changes on the revised pages are shown by marginal lines.

1.0 LIMITING CONDITIONS FOR OPERATION

2. No discharge of heated wastes, except for cooling tower blowdown, shall be made from the plant when the temperature of the river upstream of the condenser water inlet is 70°F or higher.

3. The discharges of heated water shall be controlled so that the rate of change due to operation or normal startup or shutdown conditions shall not exceed 0.5°F per hour from May 1 through October 31 nor 1.0°F per hour from November 1 through April 30, as measured at the upstream and downstream monitors.

4. Thermal discharges into the Vernon Pond will be controlled so that the resultant temperature at the periphery of a 50 acre zone shall not exceed 45°F when the ambient river water temperature is less than 40°F or increase more than 5°F when the ambient river water temperature is above 40°F.

5. From September 6, 1976, through May 31, 1977, conditions 1 through 4 under Section 1.1.A will be superceded by conditions a, b, and c below for the purposes of conducting monitoring described in Section 2.0 below. If Vermont Yankee terminates the open cycle tests, the

2.0 SURVEILLANCE REQUIREMENTS

2. Mixing zone configuration and extent shall be monitored as described in Table 2.2-1, "Temperature Monitoring Survey" (as modified for the temporary operating license). The results of the temperature monitoring program shall be used to establish the 50 acre zones under varying river flows for open-cycle operation.

3. From September 6, 1976, through May 31, 1977, the biological and thermal monitoring studies shall be conducted as specified in Table 2.2-3 provided that the open cycle test program is being conducted. In the event that the open cycle test program is not being conducted, Vermont Yankee may revert to the monitoring program specified in Tables 2.2-1 and 2.2-2.

1.0 LIMITING CONDITIONS FOR OPERATION	2.0 SURVEILLANCE REQUIREMENTS
NRC shall be notified within 24 hours and specifications described herein will no longer apply and will be superceded by the previous conditions 1 through 4 of Section 1.1.A. A reduction or elimination of the thermal effluent as a result of plant outage does not constitute termination of the open cycle tests. a. The hourly averaged increase of mixed river temperature at reference Monitor #3 over that at reference Monitor #7 shall not exceed 13°F. b. The rate of change of temperature at reference Monitor #3 shall not exceed 13°F in any one hour period. c. The hourly averaged temperature at reference Monitor #3 shall not exceed 85°F during the study.	

BASES - CONDENSER COOLING WATER (continued)

Aquatic ecology investigations of the Connecticut River in the vicinity of Vernon, Vermont were undertaken by the Applicant during a four year period prior to plant operation. These investigations included qualitative and quantitative studies of the fish community, phytoplankton, zooplankton, benthic fauna, vascular plants and the physical and chemical characteristics of the river. Continuation of these studies as set forth in Specification 1.2, in conjunction with operation of the station in conformance with conditions of paragraph A of Specification 1.1, is designed to evaluate the impact of the plant on the ecosystem of the Connecticut River.

A temperature limitation in the Vernon Pond of 45°F when the ambient river water temperature is less than 40°F or an increase of no more than 5°F when the ambient river water temperature is above 40°F has been established by the Atomic Energy Commission. A 50 acre area has been exempted from these limitations for the first year during which a comprehensive study of the temperature variations in the Vernon Pond will be made. If the results of the temperature monitoring survey and the results of the operational monitoring program provide information which shows that there is no significant or irreversible effects on the Vernon Pond, an appropriate exempted area will be considered. Otherwise 10 acres will be established as the extent of the exempt area. Because the thermal plume from the plant discharge is dependent on the varying river flows, no permanent exempt area is specified. Rather the location of the exempt area will be established by a temperature monitoring program described in Table 2.2-1 as modified for the temporary operating license.

Vermont Yankee has demonstrated that the controlled discharge of selected amounts of heated water directly to the Connecticut River at Vernon under certain conditions of ambient river flow and temperature have resulted in no measurable adverse impact on the water quality and biotic communities of that ecosystem. Although specifications 1.1.A.5.a and c above are more relaxed than that recommended in the FES to allow the collection of data under extreme conditions, these specifications will assure that the temperature of the river at downstream Monitor #3 during the study will be below the maximum naturally occurring temperatures of the river (85°F). This will assure that adverse affects are minimal during the study period.

B. Chlorine, in the form of sodium hypochlorite, is introduced to the condenser cooling system to control biological fouling of the traveling water screens, piping, condenser tubes and cooling towers. The free chlorine residual in the condenser discharge is maintained at a preset limit by a chlorine residual analyzer-controller. The level of chlorine used in batch injection is determined by its effective concentration within the condenser tubes by the need to avoid deleterious effects in the discharge effluent and by the relative high cost of chlorine. The batch treatment is administered twice per day for 40 minute periods.

TABLE 2.2-3

I. HYDROGRAPHIC

A. Hydrothermal Surveys During Minimum Flows

Hydrographic studies will involve field surveys to measure the distribution of heat in the region of the Connecticut River adjacent to the plant site and below the dam primarily during periods of impoundment. Hydrographic studies are proposed that will determine the longitudinal temperature distribution below the dam considering the influx of heat from natural heat sources to the Connecticut River such as the Ashuelot River, heat exchange with the atmosphere and longitudinal dispersion. Two major survey periods are planned. The first survey period is planned for September to measure the buoyant plume heat distribution during minimum flows with high heat rejection rates and the second survey period is planned for early December when ambient water temperatures cause sinking plumes.

B. Current Measurements

Current measurements will be taken in the Connecticut River to determine the current patterns induced by plant discharge during minimum flows. Current patterns will also be measured near the intake structure for correlation with biological data on fish entrapment.

C. In Situ Temperature Monitoring Program

The *in situ* temperature monitoring program will be continued and include temperature measurements at Vernon Hydroelectric Station.

II. BIOLOGICAL STUDIES

1. Plankton

Phytoplankton and zooplankton will be sampled once monthly (river flow and ice conditions permitting) at stations: 7 Monitor, 7 midstream, 5 midstream, 4 Vermont quarter, 4 New Hampshire quarter, 0.1 mile north of Vernon Dam, 3 Monitor and 3 midstream.

2. Entrainment

Duplicate entrainment samples will be taken twice monthly at approximately two week intervals when the plant is operating in hybrid or open cycle. Intake samples will be taken from the river in front of the trash racks at the intake structure. Condenser discharge samples will be taken in the "hot bay" (this is the first accessible point where samples can be collected after the cooling water has passed through the condenser). Samples will be taken at appropriate intervals (depending on the number of circulating pumps running) to insure that the same water mass sampled at the intake is sampled at the discharge. Samples will be examined promptly after collection to ascertain the numbers of living and dead phytoplanktons and zooplanktons Detailed taxonomic determinations will be made later in the laboratory. Chlorophyll determinations will be made on all samples.

3. Benthos

Benthic fauna will be sampled (one sample equals five Ekman dredge hauls at river quarter points) at each of the following stations in May: 7, 5, 4, 3, 2, and 1. In addition, if river flow and ice conditions permit, benthic samples will be taken at stations 7, 3, 2, and 1 in September, October, November, December, January, February, March, and April. It is anticipated that the probability of collecting the December-April samples may be small due to weather conditions.

4. Impingement

Cooling water intake screens will be backwashed once daily. Fish found on the screens will be counted, identified, weighed, and measured; the data will be recorded in a log. Service water screens will not be backwashed (these screens are backwashed automatically and any fish impinged will be accounted for in the cooling water backwash count).

5. Finfish

Finfish will be sampled (river flow and ice conditions permitting) twice each month at approximately two week intervals. Gill nets and/or trap nets will be set at locations in and (when possible) out of plume. All specimens captured will be counted, identified, weighed, and measured; in the spring all specimens will be checked for condition (maturity, degree of reproductive ripeness, etc.) to ascertain if there are any indications of premature spawning. All data will be recorded in a log.

6. Live Cage Studies

Brown Trout (or salmon if available) will be placed in live cages at stations 7, 4 in plume, 4 out of plume and 3 for ten day periods once each month when river flow and ice conditions permit. Cages may be placed at additional downstream stations if it is felt this will produce useful information.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

ENVIRONMENTAL IMPACT APPRAISAL BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 28 TO LICENSE NO. DPR-28

VERMONT YANKEE NUCLEAR POWER CORPORATION

VERMONT YANKEE NUCLEAR POWER STATION

DOCKET NO. 50-271

Introduction

By letter dated July 8, 1976, the Vermont Yankee Nuclear Power Corporation (VYNPC) requested a change to the Vermont Yankee Environmental Technical Specifications (Appendix B of Facility License). By letter dated August 12, 1976, VYNPC submitted letters received from the appropriate regulatory agencies of Vermont and New Hampshire granting authorization in support of VYNPC's request to conduct the Phase IV Hydrothermal and Biological Studies Program.

In the present technical specifications, limitations are put on far-field temperature increase over ambient, the rate of change of downstream temperature and the size of the thermal plume. In the proposed technical specifications, no limitation is put on the size of the thermal plume and the far-field temperature increase limitation and rate of change limitation are increased.

Vermont Yankee has demonstrated during three previous studies (Phase I, February - April 1974; Phase II, December 1974 - May 1975; and Phase III, October 1975 - May 1976) that the controlled discharge of selected amounts of heated water directly to the Connecticut River at Vernon under certain conditions of ambient river flow and temperature have resulted in no measurable adverse impact on the water quality and biotic communities of

that ecosytem. These three studies have resulted in valuable knowledge of the effects of heated water on the aquatic ecosystem at Vernon; however, there still exists several gaps in our knowledge that should be closed to derive maximum benefits from the studies. The proposed specifications will allow studies to be done to further close these gaps.

The purpose of the four phase testing program is to gather biological and hydrothermal data under specific conditions in an effort to show that no significant impact to the environment is caused by open cycle operation. The data from all four phases will provide a basis for making application for a 316A demonstration which, if approved, will permit open cycle operation under specified conditions. Open cycle operation would permit a higher degree of operational flexibility and would yield a net increase of approximately 25 MWe.

We have made certain minor modifications to the original proposal from Vermont Yankee Nuclear Power Corporation. These modifications have been discussed with the licensee and they have agreed to them.

This appraisal is divided into two principal parts. The first part describes the biological impacts that have been observed so far and the additional impacts that may be expected based on the hydrothermal plume analysis under the open-cycle test program. The second part (Appendix A) describes the size and extent of the plume under conditions of low river flow and open cycle plant operation.

BACKGROUND

Description of the Phase Programs

Table 1 lists the dates, cooling modes and river flows for the four phase programs. Information that was gathered in each program was used to refine the sampling in succeeding programs. As a result, the amount of information obtained has increased greatly with each succeeding program. Also, the amount of heat that the plant released during each program has gradually increased as the results of each program were analyzed and shown to have no impact. Phase I was the most conservative with hybrid operation during the coldest months. Phase II was less conservative than Phase I because 25% of the time the plant operated in open cycle and the program was extended one additional month into May when the water got warmer. Phase III was less conservative than Phase II because more than 50% of the time the plant operated in open cycle and the program started early in the fall when the water temperature was still warm and extended an additional month into June when the river flow started dropping and the water temperatures began to rise. Phase IV is the final program in this series. It will start in September, one month earlier than the Phase III program, and will end in June. It will also be different than the Phase III program in that the plant will operate open cycle throughout its entire duration. The results of the three programs completed so far indicate no significant impact to the aquatic biota of the Connecticut River.

TABLE 1

PHASE	DATES	COOLING MODE	RIVER FLOW CFS
I	Feb. - Apr. 74	hybrid & closed	8800 - 67,000
II	Dec. 74 - May 75	open, hybrid & closed	1,232 - 38,440
III	Oct. 75 - June 76	hybrid & open	9,803 - 34,092
IV	Sept. 76 - June 77	open	1,200 - 40,000

BIOLOGICAL EVALUATION

Phytoplankton

Vermont Yankee has conducted extensive phytoplankton monitoring in the vicinity of the plant. They have submitted annual and semi-annual reports for the past four years, and in addition, have submitted reports from two intensive "phase" studies[1,2] and have provided us with a draft copy of the third.[3] They have collected data over a wide range of river flow conditions and heat rejection rates. These data have never illustrated a statistically significant difference in the phytoplankton population within the plume as compared to that outside of the plume or downstream of the plant as compared to that upstream of the plant.

Total phytoplankton counts were made in these studies of three indicator organisms, *Asterionella formosa*, *Melosira sp.* and *Tabellaria flocculosa*. In the Phase I study (February - April, 1974) the average value of ten measurements over the period at upstream station number 7 and downstream station number 3 was within 92% agreement, for the Phase II study (December 1974 - May 1975) this value was within 63% agreement for 13 measurements, and for the Phase III study (October 1974 - June 1976) this value was within 82% agreement for 17 measurements. These numbers suggest that there is no difference between the downstream and upstream concentrations as it is generally considered that because of natural variability and sampling difficulties that concentration can be determined to within no better than 50%.

During several months of the Phase III study the plant operated in a once-through mode. Even during these months no detectable difference in the phytoplankton populations was observed. In the Phase IV study, once-through operation will be started earlier in the year when the river flow is somewhat lower than that which occurs during the colder months. Nevertheless, no significant impact will occur to the phytoplankton populations during the Phase IV test program because the river temperature downstream of the plant will always be lower than that which occurs naturally in the summer. This assures that the heating of the water during the study will not have a significant impact on the populations because, although it is possible that species which ordinarily are present only in the summer will be present during some period of the Phase IV tests, there is no risk that cold water species of the river will be destroyed as these species must be able to withstand the warmest summer temperature. Furthermore, there is no risk that obnoxious blooms of algae will occur during the Phase IV tests because such blooms do not occur during the summer when, because of natural conditions, the temperature is as high or higher.

Zooplankton

Vermont Yankee's monitoring program of zooplankton is very similar to their phytoplankton monitoring program. The data they have collected show as much variability among replicate samples as between different stations and no statistically significant difference in population occurs between those observed within the plume as compared to those observed outside of the

plume or downstream of the plant as compared to upstream of the plant. In the Phase I study the average value of eleven measurements at upstream station number 7 and downstream station number 3 was within 76% agreement, for the Phase II study this number was within 70% agreement for nine measurements, and for the Phase III study this number was within 82% agreement for seventeen measurements. Typically, zooplankton populations can change by a factor of ten or more from one month to the next due to changes in physical conditions of the environment, to availability of food sources, and presence of predators. The above numbers show remarkable agreement for a naturally occurring situation as natural patchiness in distribution of populations and sampling technique errors above can introduce variability greater than 50%. These numbers strongly indicate that the plant has no impact on these populations.

Data collected during the Phase III study show that the plant has little or no destructive effect on zooplankton passing through the condenser during open cycle operation. In this report, several samples were taken at the intake and discharge structures and the fraction of living zooplankton were determined. The average percent living at the intake structure was 79% and at the discharge structure was 71% for 21 samples at each location. These two numbers have standard deviations of 31% and 28% associated with them respectively, and as such, indicate that there is no significant statistical mortality caused by passage through the condensers in the open-cycle mode of operation.

During several months of the Phase III study the plant operated in a once-through mode. During these months no detectable difference in zooplankton populations were observed. In the Phase IV study once-through operation will be started earlier in the year when the river flow is somewhat lower than that which occurs during the colder months. Nevertheless, no significant impact will occur to the zooplankton populations during the Phase IV test program because the river temperature downstream of the plant will always be lower than that which occurs naturally in the summer. This assures that the heating of the water during the study will not have a significant impact on the populations because, although it is possible that species which ordinarily are present only in the summer will be present during some period of the Phase IV tests, there is no risk that cold water species of the river will be destroyed as these species must be able to withstand the warmest summer temperature.

Benthos

Benthos have been sampled for several years at Vermont Yankee. The sampling program conducted during the Phase II, 1975, program was more extensive than previous years and was designed to establish whether the heated discharge has had an effect on the benthos organisms in the plume areas. Chironomid larvae were the predominant group of organisms observed in most samples in February through May. Only at the early part of this period was there a greater number of these organisms near the discharge. Their excessive numbers is thought to have been caused by heating in the colder months.

During the Phase II study many samples were collected during the winter months. In previous years this was not done because it is difficult to

sample when the river freezes. The diversity and numbers of organisms found in these samples was as great or greater in downstream samples as compared to upstream samples, indicating a possible positive effect of the heating. The populations varied much more from colder months to warmer months than from areas outside the thermal plume to areas within the thermal plume. Overall, the data do not suggest that there is any undesirable effect of the thermal plume on the benthos populations near the plant, and that there could be a desirable effect during colder months.

The benthos populations downstream of Vernon Dam may experience rates of temperature change as great as 13°F/hour when the hydrothermal dam suddenly begins or stops releasing large amounts of water. Although no benthos data have been collected at the station that allow a quantitative prediction of the level of this impact it is not expected to be significant since much of the benthic regeneration occurs in summer months. Furthermore, it has been observed numerous times that after benthos populations are destroyed the areas are quickly repopulated.[6,7] Even if all the benthos organisms are killed for several miles downstream of the plant 75% recovery would be expected after the first summer and close to 100% recovery would be expected after the second summer.

Fishes

The fish populations in Vernon Pond have been studied for several years by the licensee under the "Phase" programs. Sampling of the fish populations has been done by means of two techniques, fish trap nets

and gill nets. The trap nets have proven much more effective in sampling the populations than have the gill nets. These studies have shown that the fishes tend to stay on the New Hampshire side of the river, apparently because of the differences in the two types of habitat on the two sides of the river. Trap nets in April, 1974 caught fish at a 9.5 times greater rate near the New Hampshire shore than near the Vermont shore; and, in the following year during April and May, the trap nets caught fish at about a 10 times greater rate near the New Hampshire shore than the Vermont shore. In the Phase III study extensive trap net sampling was done (November - June) in the vicinity of the discharge structure, within the 5°F thermal plume boundary, and downstream of the discharge structure along the Vermont shore in Vernon Pond. The rate at which fish were caught outside of the plume was about 5.8 times greater than within the plume possibly indicating that the fish population tends to avoid the areas of the heated plume.

During the Phase I, II and III studies, Salmo trutta were kept in underwater cages within and out of the area of the 5°F thermal plume. Six fish were placed in a cage and left for ten days. There were cages located in eight locations, one upstream and one downstream from the plant, one in the immediate vicinity of the discharge, and five further away from the discharge but in the near vicinity of where the 5°F thermal plume isotherm is usually found. Fish were placed in the cages at several different times during the year. At the end of each 10 day period the

cages were retrieved and the numbers of survivors in each cage were logged. Generally six fish were put in each cage.

The data from the Phase I study show a much lower survival rate than for the later two studies and are not considered valid because the cages were a poor design which subjected the fish to stresses through continuous exposure to currents. The data from the last two studies indicate that survival probability is slightly lower in the cage located closest to the discharge structure (72%). The five cages located in the thermal plume area and upstream and downstream of the plant had a higher survival rate of 84% or a difference of 12%.

These numbers were determined by observing the survival of more than 400 fish. The species Salmo trutta was used because, as compared to other species which are found in the vicinity of the station, it has a low thermal tolerance.[4,5,8] Hence, the 12% mortality difference is a conservative estimate for the entire fish population.

The data from the fish trapping studies indicate that the population tends to reside on the New Hampshire side of the pond and not near the discharge. This is probably partly due to fish trying to avoid the heated discharge. The section of this appraisal on the thermal plume suggests that the size of the thermal plume will probably be significantly larger during the Phase IV study than it has been in the past. As concluded in the hydrothermal evaluation, the 5°F isotherm will probably be between 135 and 200 acres in size. In the FES we recommend that a 50 acre area

be made available during the first year for study purposes. The present technical specifications require that the thermal plume area be no greater than 50 acres, but because of other thermal criteria, the actual plume size has been measured to be generally less than 10 acres. The data do not indicate that any of the aquatic biota have been affected because of this plume, except for fish that were held in cages near the discharge structure. One hundred thirty-five to two hundred acres is a large fraction of the pond. The thermal plume will likely extend across the pond to the New Hampshire side where the fish populations are more dense. As the discussion on page 10 suggests, some of the fish will try to avoid the heated water by swimming upstream. This will cause a temporary redistribution of the fish population in Vernon Pond. The fish that remain in the pond are likely to experience slightly higher mortality.

It is likely that during the fall and winter months of the year when the water temperature is low and the area flow rates are high (October - March) the effect of the proposed study on the populations will be nil and that only during September, April, and May could there possibly be negative effects on the fish population. Furthermore, the study will not be conducted during the times of the year that the impact would be most severe, i.e., during June - August when the ambient river temperature is the highest and the river flow rates are the lowest. Also, none of the fishes found in the area are species which are exceptionally fragile or are likely to become extinct in the area because of the study; rather, they represent species that are known to be resilient to impact and adaptable to environmental change. Even if large

fish mortalities occur in Vernon Pond during September, April, and May, which we believe to be unlikely, it is acceptable on the basis that it will affect less than 1% of the river and the pond will be quickly repopulated with fish from upstream of the plant. Fishes downstream of Vernon Dam will not be detrimentally affected by the heating since during the warmest month of the study the temperature of the water below the dam will be below the maximum natural variability.

The proposed technical specifications allow the rate of change of water temperature to be as much as $13^{o}F$ in any one hour period downstream of Vernon Dam. Data obtained from the cage studies suggest that this variation will not have a significant effect on the fish populations downstream of the dam. The temperature within the cages fluctuated most during the coldest months of the year, e.g., in February 1975 the temperature in a cage in the plume varied over a range of $13^{o}F$ every 15 minutes which amounts to a rate of temperature change of $52^{o}F$/hour. No mortality was observed at this location during the winter months. The cage studies suggest that the sustained temperature increase is the important factor in increasing mortality and not the variation in temperature. As the species used in the cage studies are known to be relatively temperature sensitive, changing temperature caused by the plant in conjunction with the operation of the hydroelectric plant at Vernon Dam is likely to have an insignificant detrimental effect on the fish populations downstream of the dam.

Conclusions For Negative Declaration

We have reviewed Vermont Yankee Atomic Power Corporation's Proposal Technical Specifications for Vermont Yankee Nuclear Station. We have modified them slightly and have assessed the impact of the modified changes. We have reviewed the conclusions and data of the Phase I, II, and III studies and based on these data we have concluded that the modified changes to the Technical Specifications will not result in significant adverse effects to the environment. On the basis of these conclusions, we find that a Negative Declaration of the proposed action is appropriate.

Dated: September 7, 1976

References

1. Hydrothermal and Biological Studies, Phase I. February - April 1974. Aquatec, Inc. South Burlington, Vermont.

2. Hydrothermal and Biological Studies, Phase II. December 1974 - May 1975. Aquatec, Inc. South Burlington, Vermont.

3. Hydrothermal and Biological Studies (draft) Phase III. October 1975 June 1976. Aquatec, Inc. South Burlington, Vermont.

4. Sylvester, J. R., Possible Effects of Thermal Effluents on Fish: A Review. Evniron. Polut. (3) 1972.

5. Industrial Waste Guide on Thermal Pollution. U. S. Department of the Interior. Pacific Northwest Water Laboratory. September 1968.

6. Gross physical and biological effects of overboard spoil disposal in Upper Chesapeake Bay. NRI Special Report No. 3. Chesapeake Biological Laboratory, Solomons, Maryland.

7. Saila, S. B., S. D. Pratt, T. T. Polgar. Dredge spoil disposal in Rhode Island. 1972. University of Rhode Island, Kingston, Rhode Island.

8. Final Environmental Statement related to the operation of Vermont Yankee Nuclear Power Station, July 1972. U. S. Atomic Energy Commission.

APPENDIX A

Hydrothermal Evaluation

Several sources of information and methods of analyses are available to estimate the thermal effects of the Phase IV study plan. These include regression analyses of the data from previous operation modes, preoperational dye studies, and the staff's early mathematical models.

Regression Equation

The licensee has formulated a phenomonological model relating thermal plume area in Vernon Pond to the parameters of river flow, plant flow and plant ΔT, based on the thermal surveys performed since the commencement of plant operation.[1,2,3] For a river flow of 1270 CFS, a plant flow of 840 CFS, and a plant ΔT of 19.7^{o}F, the area within the 5°F isotherm computed by the regression equation was about 20.2 acres. This value is clearly too small in light of the conclusions reached from the dye experiments discussed below.

The regression equation was based on correlations of field data for conditions of much higher river flow rates. It should not be expected to be applicable beyond the range of the correlated data.

Dye Release Experiments

The licensee conducted several preoperational dye release experiments at the site by introducing dye into unheated water discharging from the plant discharge structure.[4] Experiments were performed with river

flows ranging from an average of 1270 CFS, which represented a flow slightly greater than the minimum allowed for releases by the Environmental Technical Specifications, to 9500 CFS. In all cases, the plant discharge was held at about 840 CFS, representative of once-through full power operation.

The dye experiment temperature projections compared favorably with observed prototype field data, at least under conditions where the plume discharge did not stratify significantly and river flow rates were much greater than the minimum. Based on preliminary staff analyses, however, it is not likely that the dye release experiments would closely predict prototype thermal plumes. Several weaknesses of the dye study are apparent:

1. A simple energy budget on the control volume encompassing Vernon Pond, see Figure 1, can be formulated including heat input from the plant, heated water released from the dam, and heat transfer to the atmosphere. Such a balance clearly shows that water leaving Vernon Pond would have a temperature elevation of about 12°F as it was released from the dam, if the system were at steady state. The dye predictions seem to indicate that the water leaving the dam has a temperature elevation of about 8°F.

   This difference in release temperatures is too great to be explained by the lack of precision of the control volume approach but may have been caused by one of the following reasons. If the release through Vernon Dam were held steady at 1270 CFS, but the flow from upstream were greater, the stage of Vernon Pond would increase, diluting the dye more than expected. This would account for the lower apparent temperature. Alternately, there is a strong indication that the dye experiment was not allowed to reach steady state at the flow rate of 1270 CFS. A

rough computation of the time to reach 99% of the steady state, based on steady flows through the control volume of Vernon Pond, gives a value on the order of 5 to 10 days. It was not apparent that the dye studies were run for this long. Hence, the dye concentration possibly did not build up to the steady state level.

2. Conditions of low flow in Vernon Pond are conducive to marked stratification. Therefore, dye tracer experiments with unheated effluent would not be expected to faithfully replicate the prototype conditions. Preliminary computations (subsequently discussed) based on the density difference between the expected temperature of water in Vernon Pond and cool upstream water indicate a strong thermal wedge extending well upstream from the discharge area even further than indicated by the dye study.

Motz-Benedict Model

The staff presented analyses of the thermal plume in Vernon Pond in the Final Environmental Statement.[4] This analysis was based on the application of the Motz-Benedict jet model for surface discharges [5] and a river flow rate of 1200 CFS.

The analyses do not account for the modification of the flow field in Vernon Pond due to the intake and discharge flows, each representing about 2/3 of the total flow in the river. Entrainment flow to the jet would be severely limited simply by the lack of available water flowing through the pond. The effects of interference of the jet with the shorelines were not completely addressed in the analyses. Although many of these deficiencies

were recognized, the attempts by the staff to modify the results to reflect the deficiencies were not totally successful.

Present Analysis

As noted above, the previous analyses were not entirely adequate to predict the size and location of the thermal plume for the proposed mode of operation. This is, of course, one purpose of the Phase IV study. However, the dye release experiments contain information, which if modified to correct the noted deficiencies, can be used to estimate the extent of the thermal effects caused by the plant, under the assumptions of a sustained low river flow of 1270 CFS, a plant flow rate of 840 CFS, and a plant ΔT of $19.7^{o}F$.

The dye tests are useful in several respects in spite of their deficiencies for the following reasons:

1. The tests were performed at the site with the actual intake and discharge facilities;
2. The river and plant flow rates approached those desired for the Phase IV study;
3. Real-world anomalies of flow and bathymetry were naturally present. These factors contribute realism to the tests compared to mathematical approximations inherent in other analyses.

We utilized both an arrested thermal wedge analysis and a heat budget analysis to modify the dye study results. The wedge analysis indicated that under prototype conditions of thermal discharge, the Pond would stratify, with a resulting increase in the area within the $5^{o}F$ isotherm, causing it to extend farther upstream than indicated by the dye study. The area of Vernon Pond

within the $5^{o}F$ isotherm, according to the dye studies, is about 135 acres. The temperatures in Vernon Pond would be higher than predicted by the dye release experiments because, as previously noted, either the pond volume was not held constant, or the experiments did not reach steady state. This fact would further increase the estimate of the area within the $5^{o}F$ isotherm. Our analysis of the thermal wedge resulted in an estimated maximum area within the $5^{o}F$ isotherm of 200 acres.

The effects of stratification would probably cause the upstream extent of the thermal plume to increase beyond the intake structure. Lacking the facility for selective withdrawal (e.g., a skimmer wall), there would probably be recirculation of heated effluent. This would cause the water leaving the discharge structure to be even hotter than the $19.7^{o}F$ above ambient which would be predicted if there were no recirculation (i.e., the natural Pond temperature plus the plant ΔT of $19.7^{o}F$).

The heat budget analysis involved the plant heat rejection, the Pond inflow and outflow, and heat transfer from the surface of the pond. The analysis showed that surface heat transfer from Vernon Pond would be relatively unimportant, causing only a minor decrease in temperature of the water before it released through the dam. Thus, the temperature of the water downstream at monitoring station 3 would be about $12^{o}F$ above ambient at the stated conditions of flow and ΔT.

Hydrothermal Conclusions Used in Biological Evaluation

The best estimates of the thermal effects from the plant at the specified conditions are:

1. The area within the $5^{o}F$ isotherm in Vernon Pond will be greater than 135 acres but less than 200 acres;

2. The temperature of water downstream from the dam at station 3 will be about $12^{o}F$ above ambient;

3. The above stated effects apply only for sustained low river flow and full power once-through operations. These conditions would have to be in effect for several days before steady state would be reached.

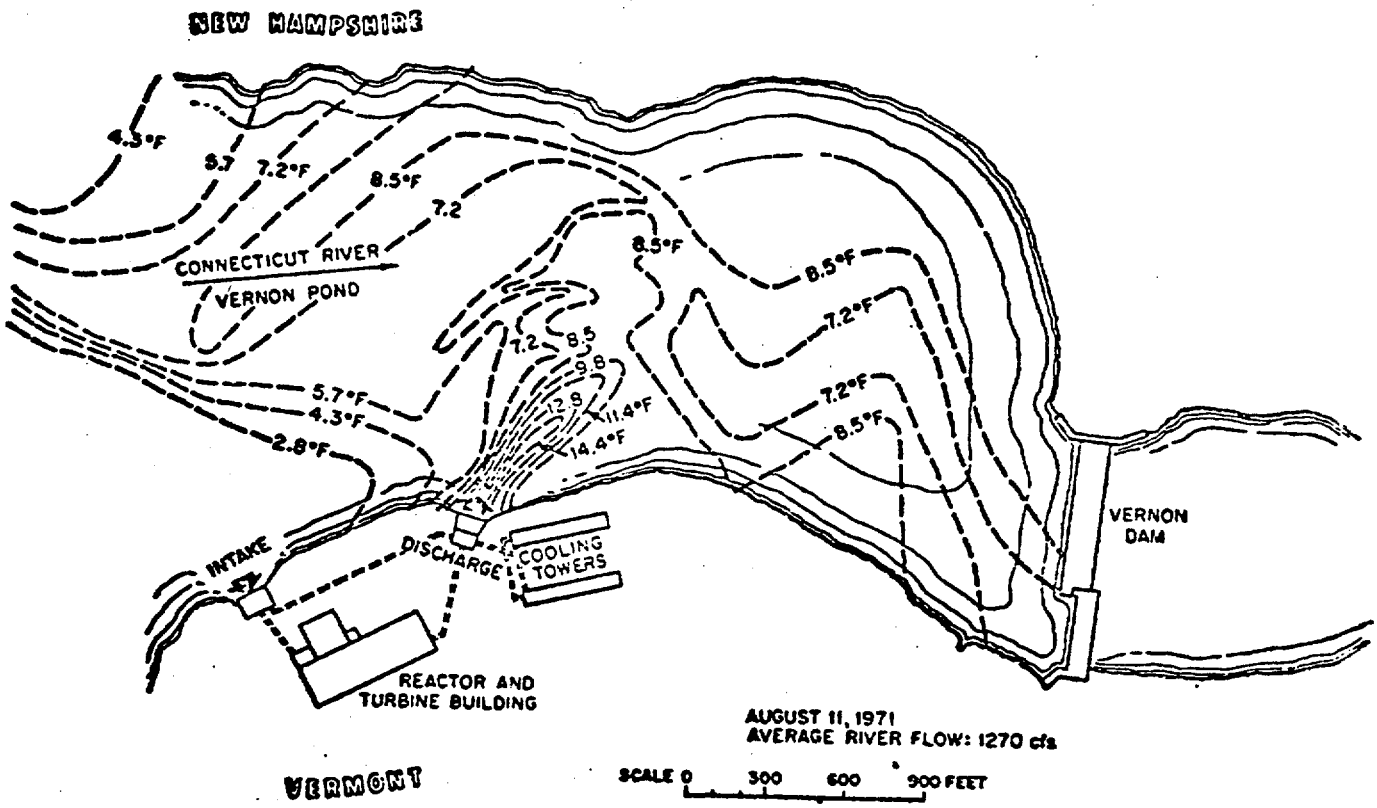

Fig. 1 Temperature Increases in Vernon Pond as Calculated from Dye Concentrations at a River Flow of 1270 cfs.

APPENDIX A REFERENCES

References

1. Hydrothermal and Biological Studies, Phase I. February - April 1974. Aquatec, Inc. South Burlington, Vermont.

2. Hydrothermal and Biological Studies, Phase II, December 1974 - May 1975. Aquatec, Inc. South Burlington, Vermont.

3. Hydrothermal and Biological Studies (draft) Phase III. October 1975 -

4. Final Environmental Statement related to the operation of Vermont Yankee Nuclear Power Station, July 1972. U. S. Atomic Energy Commission.

5. L. H. Motz and B. A. Benedict, "Heated Surface Jet Discharged into a Flowing Ambient Stream," Vanderbilt University, Nashville, Tennessee (August 1970).

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-271

VERMONT YANKEE NUCLEAR POWER CORPORATION

NOTICE OF ISSUANCE OF AMENDMENT TO FACILITY OPERATING LICENSE

AND NEGATIVE DECLARATION

The Nuclear Regulatory Commission (the Commission) has issued Amendment No. 28 to Facility Operating License No. DPR-28 issued to Vermont Yankee Nuclear Power Corporation which revised Technical Specifications for operation of the Vermont Yankee Nuclear Power Station, located near Vernon, Vermont. The amendment is effective as of its date of issuance.

The amendment modifies the limiting conditions of operation and surveillance requirements related to the discharge of condenser cooling during the period September 6, 1976, through May 31, 1977, to permit the acquisition of special environmental information related to the effects of open cycle cooling.

The application for the amendment complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. The Commission has made appropriate findings as required by the Act and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendment. Prior public notice of this amendment was not required since the amendment does not involve a significant hazards consideration.

The Commission has prepared an environmental impact appraisal for the revised Technical Specifications and has concluded that an environmental impact statement for this particular action is not warranted because there will be no significant environmental impact attributable to the action and that a negative declaration to this effect is appropriate.

For further details with respect to this action, see (1) the application dated July 8, 1976, (2) Amendment No. 28 to License No. DPR-28, and (3) the Commission's Environmental Impact Appraisal. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, N.W., Washington, D.C. and at the Brooks Memorial Library, 224 Main Street, Brattleboro, Vermont.

A copy of items (2) and (3) may be obtained upon request addressed to the U. S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Director, Division of Operating Reactors.

Dated at Bethesda, Maryland, this 6th day of September 1976.

FOR THE NUCLEAR REGULATORY COMMISSION

Robert W. Reid

Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors