VERMONT YANKEE NUCLEAR POWER CORPORATION

Ferry Road, Brattleboro, VT 05301-7002

REPLY TO
ENGINEERING OFFICE
580 MAIN STREET
BOLTON, MA 01740
(508) 779-6711

July 10, 1992
BVY-92-082

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

References: (a) License No. DPR-28 (Docket No. 50-271)
(b) Letter, VYNPC to USNRC, BVY 91-113, dated November 18, 1991
(c) Letter, USNRC to VYNPC, NVY 92-23, dated February 18, 1992

Subject: Response to Request for Additional Information and Resubmittal of Request to Dispose of Slightly Contaminated Soil in Accordance with 10CFR20.302(a)

Dear Sir:

By Reference (b), Vermont Yankee applied under 10CFR20.302(a) for approval of a proposed alternative disposal method of licensed materials by leaving in place radioactively contaminated soil and fill material located under existing plant structures and buildings.

NRC requested additional information via Reference (c). Accordingly, please find Vermont Yankee's responses to NRC's request of Reference (c). Also, please find attached a revised application document incorporating, as appropriate the information given in response to the questions in Reference (c). This application document replaces that submitted by Reference (b) in its entirety.

Should you have additional questions with regard to this application, please contact this office.

Very truly yours,

Vermont Yankee Nuclear Power Corporation

Warren P. Murphy
Senior Vice President, Operations

Attachment
cc: USNRC Region I Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS

RESPONSE TO NRC REQUEST FOR FURTHER INFORMATION ON VY CHEM SINK

05/15/92

1. Provide addition information (i.e. calculations) to support the assumption that 58,500 cu ft of soil may be contaminated.

ANSWER:. This volume as a worst case scenario, was calculated based on the extremely conservative assumption that the entire 150 ft length of pipe failed and a 120° zone of contamination extended from the pipe down 15 feet to bedrock. In reality, there may only be an approximate 120° conical zone of influence extending down about 15 feet from the failed elbow in the pipeline, and contaminating a volume of about, or less than 10,600 ft^3. The larger, more conservative value was selected to emphasize the limited extent of the contamination. It is believed, because of uncertainty about the zone of contamination, a conservative estimate of the total activity can best be made by assuming that the normal laboratory sample volume of 10 liters of reactor coolant water per week was discharged to the sink over an extended period of 10 years, and that all of that water leaked from the pipe into the soil under the Chemistry Laboratory floor.

2. Clarify the basis for reporting the radionuclide concentration on a "wet" basis instead of a "dry" basis. Provide the concentration on a "dry" basis, if available.

ANSWER: The samples were analyzed in the "as found" moist condition without oven drying, and thus, were reported as "wet", which is standard environmental laboratory practice for "in-situ" sample reporting (other than sediment samples). The laboratory has indicated that the moisture content of these samples would not be expected to exceed 10-20%, by weight. A change in density of this magnitude would not significantly affect the resulting radiological impact, given the uncertainties in other assumptions.

3. There is an unusually large distance gap between the sample taken at 37.5 inches and the next one at 85.5 inches compared to the relatively uniform spacing on the other samples. Since the 37.5 inch sample has the highest concentration, it would seem prudent to have taken samples above and below that level to obtain a more detailed profile of the spatial distribution of the contamination. Provide justification for this gap or provide data on soil boring sample results for depths closer to the 37.5 inch level, and revise the appropriate data tables.

5. The graph titled "BORING MW-1" presents a misleading representation of the distribution on contamination. The x-axis plots the sample depth in a linear manner, which it is not. Additionally, as discussed in question 3, the large gap of missing data between the highest concentration sample and the next sample skews the data representation. Provide a revised graph (including data from question 3) that appropriately reflects actual scale.

ANSWER: The spacing of samples taken for analysis in boring MW-1 was as consistent as sample recovery allowed. Correct sample depths are shown on the graph titled "Boring "MW-1"". Some of the depths of samples presented in Table 1 are off by 1 ft; a corrected copy of this table is attached. This discrepancy resulted from the use of both the top and the bottom of the lab floor as a datum for sampling during the course of the boring operation, and the fact that these reference points were established as exactly 1 ft apart. This difference was recognized and corrected as part of the original analysis of the data, however, the original values were mistakenly included in Table 1. The graph has been re-plotted using "inches" rather than "feet and fractions" as the abscissa.

4. Provide the basis for assuming that disposal of 10 liters/week of radioactive material is a conservative value. Provide information on sample analysis and routines to support your answer.

ANSWER: Vermont Yankee Technical Specification 4.6.B.1.a. states "a sample of reactor coolant shall be taken at least every 96 hours and analyzed for radioactive iodines of I-131 through I-135 during power operation". Section 4.6.B.1.b, states "an isotopic analysis of a reactor coolant sample shall be made at least once per month". Conversation with plant chemistry personnel and review of completed plant chemistry procedures indicates 1 liter samples are collected and brought to the laboratory for analysis on a daily basis. The basic assumption is that these samples were disposed in the laboratory sink, under the assumption the contents was going to the Chemical Drain Tank. One sample per day equates to 7 liters per week. This value was rounded up to 10 liters per week.

A 100 ml aliquot of the monthly sample is analyzed for gamma emitters. A review of several years worth of data indicated that recent results were somewhat higher than earlier analyses and would represent a conservative basis for determining the total activity that may have been disposed to the sink over a protracted time period. Therefor the most recent results available were used to estimate the radionuclide concentration of gamma emitters. A sample of reactor water, taken in the same time frame, was analyzed by the Yankee Atomic Electric Company, Part 61 Laboratory for all radionuclides important to 10CFR61. The results of these analyses provided the basis for the estimate of radionuclide concentration and distribution.

It is reasonable to assume that the drain leak began as a small corrosion hole in the drain line near the elbow. This allowed small quantities of liquids to leak into the soil. As time progressed, the corrosion continued and the leak increased in magnitude and an increasing fraction of the material discharged to the drain leaked. It is unlikely that the entire volume of water leaked out of the pipe. Undoubtedly a significant percentage of water followed the path of least resistance, down the open pipe.Neither the exact start time, nor magnitude of leakage is precisely known, therefore it is conservatively assumed that all of the estimated liquid discharged to the sink for the previous 10 year period resulted in leakage. It is believed this approach has resulted in a conservative estimation of the total activity that may have been discharged to the sink and the calculated radiological impact represents the upper bound of exposure.

6. Due to methodology errors that were found in the January 1990 draft of NUREG/CR-5512, use of that methodology is not appropriate. Provide a reanalysis using other available methodology.

ANSWER: Only the on-site intruder drinking water pathway was analyzed using the NUREG/CR-5512 methodology, which is now reanalyzed. A conservative intruder drinking water scenario can be postulated in which a family settles on site 20 years in the future after plant closure and digs a shallow well to obtain its drinking water needs. It is postulated that the total activity is that presented in the right hand column of Table 7, i.e., 10 years of weekly releases followed by 20 years of decay, forms the activity source term. It is further assumed that none of the activity has migrated nor has any of the activity been retarded in its movement to an "underground pool", which is the source of drinking water. Using the assumption presented in the Final EIS for 10CFR61 (Ref. 1) for natural percolation of precipitation into a groundwater system, the measured annual precipitation for the site, and assuming a small area of recharge, a conservative value of total dilution water volume (and hence specific activity) can be postulated for the drinking water scenario. The methodology presented in Regulatory Guide 1.109 can then be applied to calculate the radiological impacts.

The average precipitation for Vermont Yankee for the period 1981-1990 was 40" per year. Reference 1 documents an annual precipitation rate of 41" and a percolation rate of 2.9", for a NE site. We have assumed an area of recharge consisting of a circle of 500 ft. radius (7.85E+05 sq. ft.), which represents a small fraction of the plant site upgradient from the Chemistry Laboratory. The assumption is made that a percolation rate of 2.9" per year occurs for the next 20 years. Converting this volume to milliliters, results in an "underground pool" containing 1.075+11 ml. Table A, presents the specific activities of the radionuclides of concern.

Using the data from Table A, and the methodology of Reg. Guide 1.109, (Ref.2), results in a maximum whole body dose of 6.4E-02 mrem/yr to an adult and a maximum organ dose of 1.9E-01 mrem/yr to the infant liver.

Table A*
Radionuclide Activity and Concentration

Nuclide	Total Activity[1] µCi	Concentration µCi/ml
H-3	2.6E+04	2.4E-07
Mn-54	4.9E-06	4.6E-17
Fe-55	2.6E+00	2.4E-11
Co-60	3.0E+01	2.8E-10
Cs-134	4.8E-02	4.5E-13
Cs-137	8.7E+01	8.1E-10
Sr-90	2.0E-01	1.9E-12

1. Activity from previous submittal, Table 7, 10 years of releases followed by 20 years of decay.

* Appears as Table 8 in the revised analysis

An alternate evaluation was made using the RESRAD code (Ref. 3). Assumptions for input for this program included: 1) a zone of contamination consisting of a cube whose side was equal to the depth to bedrock, 4.7 meters; 2) the activity consisted of that present after ten years of discharges (Table 5, right column) dispersed within a calculated 1.6E+05 kg of soil; 3) distribution coefficients and a hydraulic conductivity value from NUREG/CR-3332 (Ref. 4). At time equals 20 years, the total wholebody dose was calculated to be 4.6E-02 mrem/yr: essentially all from Tritium.

A third calculation was made using the methodology presented in Reference 4. This model provides a relatively simple approach to ground water transport of radionuclides. Factors considered, and values assigned, in this model are presented in the following Table B.

Table B

Groundwater Factors

Spill source model		point source
Ground water velocity		0.026 meters/day
Dispersion coefficients		2 (long), 1 (trans)
Aquifer thickness		1.47 meters
Retardation Coefficients	Co-60	860
	H-3	1
	Fe-55	1290
	Mn-54	1290
	Sr-90	18
	Cs-134, 137	173
Time since spill (years)		20
Relative well location		Highest nuclide concentration (most conservative)

The results are expressed as a radionuclide concentration in the aquifer at the well location. The radionuclide values from Table 5 as noted above, were used as initial values. The methodology of Regulatory Guide 1.109 (Ref.2) was then applied to determine the dose. A result of 3.76E-01 mrem/yr, whole body served to bound and confirm the previous two calculations.

It should be noted that the major contributor to the radiological impact of the on site drinking water pathway is Tritium. The other radionuclides, due to their low concentration, and half-life, do not add any significant contribution to dose calculated 20 years after release. The well location is critical when retardation effects are considered, and unless the well is in close proximity to a postulated plume, no significant exposure is calculated. For purpose of evaluation, it is assumed the well is located at the maximum concentration for each nuclide identified. The results of the dose analysis indicctes that even with this assumption, there is no significant dose. Tritium is assumed to have the highest concentration and no retardation, which results in the only radionuclide with the most significant radiological impact of any of the nuclides assumed in the release.

7. Provide a discussion on the correlation between the actual sample concentration and the estimated concentrations to demonstrate that using the actual concentrations would not result in higher doses. Include the data on samples tak · at the point immediately below where the pipe penetrates the floor, which had a peak Co-60 concentration of 1.1E+05 pCi/kg.

ANSWER: The original intent of the soil boring sample was to determine if the zone of contamination was local in nature, and could be readily quantified, or did it extend down to bedrock, in which case, a more detailed evaluation would be required. As the results show, contamination of Co-60 did extend to bedrock. The highest concentration scoop sample was the material directly beneath the floor and adjacent to the pipe. This volume of contamination was approximately 1 cu. ft., and it was entirely removed in the sampling process, so the activity at that concentration no longer exists.

Due to an electrical duct directly below the area of concern, the core boring could not be made directly adjacent to the pipe and was displaced laterally by approximately four feet. The boring represents a vertical profile taken through a cone of contamination whose true dimensions are not exactly known. It is speculated that the high concentration of 1131 pCi/kg from the sample taken at about 4 ft depth represented the leading edge of the Co-60 activity at that location.

If additional data were available it would likely show elevated activity from that area upward as distance from the pipe decreased, reaching a maximum adjacent to the pipe at the floor interface, possibly approaching the values measured in the scoop sample material previously removed. We do not believe the sample data are sufficient to form the bases of an estimate of total activity. The lateral extent of the contamination is not known and can not be determined without extensive corings under essential plant structures. However the data does represent a very satisfactory basis for making a conservative estimate of concentration distribution.

Alternatively, an estimate of total activity can be made from an estimate of total volume of contamination and an average concentration of activity. The total volume under the full 150 foot length of pipe has been previously estimated in the original submittal as 58,000 ft^3. (Assuming a density of 100 lb/ft^3, this is equivalent to 2.65E+06 Kg.) The average Co-60 concentration (from Table 1 of the original submittal) is 425 pCi/Kg. This results in an estimate of total activity of 1.1E+09 pCi, or, 1.1 mCi. Using the same assumptions, if the contaminated volume is 10,000 ft^3, the total activity estimate is 1.9E-01 mCi. The 10 liter per week discharge over a 10 year period results in a total Co-60 activity at the end of 10 years of 4.1E-01 mCi (original submittal, Table 5). Thus, the estimates of total activity made from estimates of contaminated volumes bound the estimate used in the analysis. It should be pointed out, that the calculated radiological impact comes from Tritium, which was estimated from the concentration measured in reactor water.

8. Provide a legible map of the disposal site with compass direction and scale, that includes local land use (e.g., buildings, nearby residences, wells, etc.).

ANSWER:. The Vermont Yankee FSAR contains site maps. We have included a copy of Figure 2.2.4, Station Plan that shows the information you request. In general the residences located on the west of the site on Gov. Hunt road have individual shallow wells as potable water supplies. As mentioned previously, the ground water flow is from west to east to the Connecticut River, and away from the residences. The Chemistry Laboratory, the source of the leakage is located in the lower level of the "Office Bldg", adjacent to the "Turbine Bldg". The grid scale of the plan is 500'. The main potable water supply for the site is provided by the "West Well", whose location is shown near the 345 KV switchyard.

9. Describe any physical or administrative barriers to prevent present and/or future intrusion into the disposal site (i.e. during building modification, repair of drain line, and decommissioning activities).

ANSWER:. An appropriate note will be placed on the building prints warning of the material beneath the floor and referencing the file number where documentation of these activities are kept.

10. What controls are in place to prevent the use of the failed drain line?

ANSWER:. The affected drain lines have been capped. The area around the failed pipe has been backfilled with concrete to the original floor line, and is now inaccessible.

11. What plans, if any, are being considered to repair or replace the failed drain line?

ANSWER: As noted in the response to question 10, the original line has been capped and is inaccessible. New piping has been run above the floor to the collection tank. This work has already been completed and is currently in use and is capable of periodic inspection to preclude a repeat of this event.

References

1. NUREG-0945, Vol. 1 Final Environmental Impact Statement on 10CFR61 "Licensing Requirements for Land Disposal of Radioactive Waste", U.S. Nuclear Regulatory Commission, November, 1982.

2. Regulatory Guide 1.109, "Calculation of Annual Dose to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluation Compliance with 10CFR50, Appendix I", rev.1, October, 1977.

3. RESRAD, ver. 4.3, USDOE, "Methodology Description for Compliance with DOE Order 54005, Chap. IV", in press.

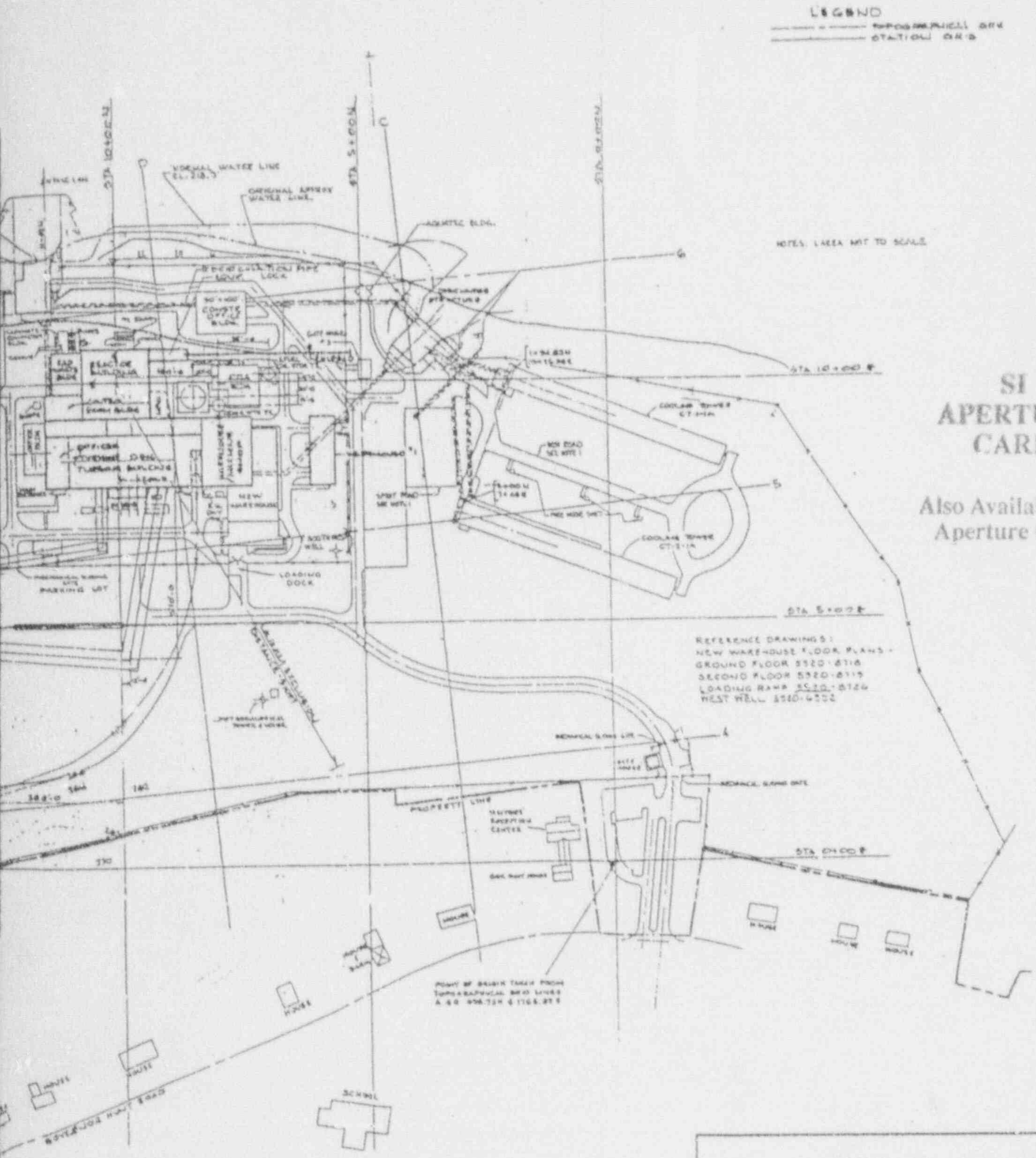
4. NUREG/CR-3332, "Radiological Assessment", Chapter 4, U.S. Nuclear Regulatory Commission, September, 1983.

TABLE 1 (Revised)

SOIL BORING SAMPLE RESULTS (Boring MW-1)

DEPTH BELOW TOP OF FLOOR (inches)	Co-60 (pCi/Kg, wet)	MN-54 (pCi/Kg, wet)
25.5	308	5
37.5	383	339
49.5	1131	914
73.5	296	12
104.5	351	1
109.5	21	7
133.5	166	<MDA
160.5	90	5
184.5	879	<MDA
AVERAGE CONCENTRATION	425	183


TRUE NORTH
PLANT NORTH
CONNECTICUT RIVER
VERMONT
LL.RAD. WASTE SITE
LEACHING FIELD
SEPTIC TANK
345 KV SWITCHYARD
WEST WELL
BARN
GARAGE
SHED
HOUSE



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Station Plan

Figure 2.2.4

REV 46

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