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October 4, 2004

Docket No. 50-271

BVY 04-110

Attn: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

References:

a) Letter, VYNPC to USNRC, "Request to Amend Previous Approval Granted Pursuant to 10 CFR 20.2002 for Disposal of Contaminated Soil", BVY 00-71, dated September 11, 2000.
b) Letter, USNRC to VYNPC, "Vermont Yankee Nuclear Power Station – Safety Evaluation for an Amendment to an Approved 10CFR 20.2002 Application (TAC No. MA9972)", NVY 01-66, Dated June 26, 2001.
c) Letter, VYNPC to USNRC, "Supplement to Request to Amend Previous Approvals Granted under 10 CFR 20.302(a) to Allow for Disposal of Contaminated Soil", BVY 00-02, dated January 4, 2000.

Subject: **Vermont Yankee Nuclear Power Station**
Request to Amend Previous Approval Granted Pursuant to 10CFR20.2002 for Increase of the Annual Volume Limit and One-time Spreading of Current Inventory

In accordance with 10CFR20.2002 (previously 10CFR20.302(a)), Entergy Nuclear Operations, Inc. (ENO) submits this application to amend the previously granted Vermont Yankee (VY) approval to dispose of slightly contaminated soil. This application requests an increase of the current annual volume limit of 28.3 cubic meters of soil as specified in the previous approval (Reference (b)) to a new volume limit of 150 cubic meters of soil. This application also requests permission to spread the current inventory of approximately 528 cubic meters of soil as described in Attachment A in a one-time spreading activity following receipt of your approval.

ENO will continue to limit the total activity spread each year to remain within the limits specified in the radiological assessment previously submitted in Reference (c).

A radiological assessment of the impact of spreading the current inventory of soils and sediments located at VY is provided in Attachment A. The assessment concludes that:

a) There is significant capacity remaining in the South Disposal Plot to continue to accept additional earthen materials for land spreading without exceeding established dose limitations.

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b) The existing inventory of waste soils in storage can be placed on the South Disposal Plot without exceeding dose impact limits previously established for a single disposal field.

c) The continued use of the South Disposal Plot will not exceed the limiting dose criteria established in the VY Offsite Dose Calculation Manual.

d) The approved dose impact methodology used to determine compliance with the on-site spreading dose limits are not driven by the volume of waste material disposed of, but by the total radioactivity content of the material that is spread over a fixed disposal plot area (1.9 acres for the South Disposal Plot). The dose modeling conservatively assumes that all radioactivity spread on the field remains in the top 15 centimeter surface layer, even after subsequent additions are placed on the same field area. Existing limits on the concentration of radioactivity in waste media provides protection from small volumes of "hot" or high specific activity materials from being spread on the disposal field.

The results of all disposal operations will continue to be reported in the Annual Radioactive Effluent Release Report. The combined radiological impact, for all on-site disposal operations, will continue to be limited to a total body or organ dose of a maximally exposed member of the public of less than one mrem/year during the period of active VY control of the site, or less than five mrem/year to an inadvertent intruder after termination of active site control.

Upon receipt of your approval, this request as well as the basis for approval will be incorporated into the VY Offsite Dose Calculation Manual.

There are no new commitments being made in this submittal.

We trust that the information contained in the submittal is sufficient. However, should you have any questions or require further information concerning this matter, please contact me at (802) 258-4236.

Sincerely,

James M. DeVincentis
Manager, Licensing
Vermont Yankee Nuclear Power Station

Attachment (1)

cc: USNRC Regional Administrator – Region 1
USNRC Resident Inspector – VYNPS
USNRC Project Manager – VYNPS
Vermont Department of Public Service

Assessment of On-Site Disposal of Contaminated Stored Soils by Land Spreading

Entergy Nuclear Operations, Inc.
Vermont Yankee Nuclear Power Station

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1.0 EVALUATION OBJECTIVE

Current restrictions on the annual volume of slightly contaminated soil (1000 ft^3 or 28.3 m^3) that can be disposed of on-site (ODCM, Appendix I, Reference 1), coupled with several plant facility construction projects in recent years, has resulted in the accumulation of a back-log of low level contaminated earthen material that is awaiting to be dispositioned by land spreading on previously approved on-site disposal areas.

The objective of this assessment is to present the data and formal evaluation to demonstrate that the proposed one time disposal of the existing accumulated backlog of soil / sand materials (as of November 2003) without regards to the annual soil volume limit, will meet the existing dose objective boundary conditions as approved by the NRC for septic waste, Cooling Tower silt and other earthen type materials (Reference 1), even if use of the same disposal field for future spreading is assumed to continue over the remaining plant operating license.

The established dose based boundary conditions (NRC approved) for disposal and accumulation of low-level contaminated septic waste, Cooling Tower silts and soil/sand mixes on designated plots within the VY site boundary will continue to be applied without change. These dose limit criteria are taken from Appendix B of Reference 1, and are:

- The dose to the whole body or any organ of a hypothetical maximally exposed individual must be less than 1.0 mrem/yr during the period that VY has active control over the disposal plots (plant operating life).
- The doses to the whole body and any organ of an inadvertent intruder following the period of active plant control over the property from the probable pathways of exposure is less than 5 mrem/yr.
- Disposal operations must be at one of the approved on-site locations.

1.1 Background

In 1989, Vermont Yankee Nuclear Power Corporation requested from the NRC permission to routinely dispose of slightly contaminated septic waste in designated on-site areas in accordance with 10CFR20.302(a). Approval from the NRC was granted on August 30, 1989, provided that the request and analysis be permanently incorporated into the plant's Offsite Dose Calculation Manual (ODCM). Revision 9 to the ODCM (Appendix B) incorporated the assessment and the approval of methods utilized for on-site disposal of slightly contaminated sewage sludge by land spreading. The approval allowed for the existing septic inventory to be disposed of on-site along with future quantities anticipated to be generated as part of routine system maintenance. For purposes of demonstrating that future addition of waste materials could be added to the disposal plots, the radiological analysis projected an annual generation rate of about 18,600 gallons of sewage containing about 1400 kg of solid materials that might require on-site spreading. NRC permission for these future disposals was granted as long as both the projected dose (for both current and all past disposal operations) and radionuclide concentration limits (≤ 10% of the 10CFR20, Appendix B, Table II, concentration values) are satisfied. No specific limit on annual volume of septic waste that could be disposed of was included in the approval.

In 1995, Vermont Yankee requested from the NRC that the previous authorization for on-site disposal of septic waste be amended to permit the on-site disposal of slightly contaminated Cooling

Tower silt material. The application analyzed the expected radiological impact from both the existing inventory at that time of about 14,000 ft^3 (~396 m^3) of accumulated silt, along with an operating cycle (18 months) generation rate of about 4000 ft^3 (~113 m^3). The NRC returned their safety evaluation, dated March 4, 1996, granting approval for the proposed silt disposal. Similar to the sewage waste disposal, NRC acceptance required that all disposal operations be conducted such that both the projected dose (for both current and all past disposal operations) and radionuclide concentration limits are satisfied. The soil concentration limits (for any sample) were based on limiting external annual dose to 25 mrem assuming continuous occupancy on an infinite plot at that concentration uniformly spread to a 15 cm depth. No specific limit on annual volume of Cooling Tower silt that could be disposed of was included in the approval. The NRC also required that any further modification to the proposed action have prior NRC staff approval.

In 1999 (with a supplemental filing in 2000), Vermont Yankee filed a third request under 10 CFR 20.2002 with the NRC to amend the previously approved applications for on-site land disposal of slightly contaminated earth type materials (septic sludge and Cooling Tower silt) to include approximately 900 ft^3 (25.5 m^3) of accumulated contaminated soil generated during construction activities within the VY Protected Area. Sampling of the soil revealed low levels of radioactivity that were similar in radionuclides and activity levels to the septic waste and Cooling Tower silts previously encountered. The request to the NRC for this additional material also indicated that additional amounts of contaminated soil / sand associated with road sweepings following winter sanding of road and walkways in the Protected Area could result in an estimated 1000 ft^3 per year (28.3 m^3 per year) that might need to be disposed of as slightly contaminated materials.

The NRC requested that the initial submittal (1999) of the soil spreading 20.2002 application include an analysis that evaluated projected future additions of an estimated annual volume of soil being added to the designated disposal plots. This information was required if Vermont Yankee intended to use the 20.2002 soil disposal application for approval to dispose of potential future volumes (i.e., not just a one-time disposal application) of low level contaminated soil in the same manner as already approved for septic waste and Cooling Tower silt. Vermont Yankee revised its application by adding an analysis for a projected annual volume of 1000 ft^3, or equivalently 28.3 m^3, of contaminated soil starting in the year 2000 and continuing on a yearly basis until end of plant license in 2013. At the end of the projected disposal stream, the accumulated buildup of contamination from all sources (septic waste, Cooling Tower silt and soil / sand mixes) on the disposal field was evaluated for both the dose impact to the critical receptor at the end of the control period and the assumed intruder. These dose impacts were found acceptable when compared against the original on-site spreading dose acceptance criteria of 1 mrem/yr (Control Period) and 5 mrem/yr (Intruder Scenario). The 1000 ft^3 (28.3 m^3) annual generation rate of soil was based on plant staff estimates that approximately that amount of soil and sand is collected from road and walkway sweepings inside the Protected Area following each year's winter clean-up as part of routine maintenance. This is the only type of earthen materials that has a specific annual volume limit associated with it in addition to the projected dose and concentration limits associated with the disposal of septic waste and Cooling Tower silt. No volume estimate for unidentified future site excavation and construction activities was provided.

2.0 SUMMARY OF RESULTS

The evaluation of the radiological impact of all past, accumulated storage inventory, and projected future waste spreading operations on a single disposal plot (1.9 acres at South end of site) have indicated the following results and conclusions:

- All past spreading of septic waste, Cooling Tower silt, and soil/sand mixes through the end of 2003 have resulted in a maximum organ dose to a critical receptor (control Period use) that accounts for only 13.7% of the 1 mrem/year limit. With respect to the Intruder dose limit of 5 mrem/year, all past spreadings through the end of 2003 account for only 7.2% of the maximum organ dose to the limiting receptor at the end of plant license.

- The impact from the projected spreading of the existing waste materials in storage is estimated to account for only 5.3% of the 1 mrem/year Control Period dose limit, or only 17.7% of the same limit when all past spreadings are combined with the materials currently in storage (as of the end of November 2003). The maximum Intruder organ dose from all past spreading and stored materials is 0.456 mrem/yr, or 9.1% of the 5 mrem/yr Intruder scenario dose limit. These results indicate that the existing inventory of waste materials in storage can be placed on the South disposal plot without exceeding dose impact limits previously established for a single disposal field.

- Assuming the same annual average generation rate of radioactivity in waste materials (septage/silt/soil) that has been observed over the last fourteen years is added to all past waste spreadings and stored soil commitments, the projected dose at the end of the current plant licensing period (year 2013) yields a limiting maximum critical receptor dose (for either the control period or inadvertent intruder) equivalent to only 25.3% of the most restrictive annual dose limit (associated with the 1 mrem/year limit for the maximum organ during the Control Period). This finding demonstrates that the continued use of the South disposal plot, even with the addition of 18,653 ft^3 of slightly contaminated soil currently in storage, will not exceed the approved limiting dose criteria established in the ODCM.

- The dose impact methodology used to determine compliance with the on-site spreading dose limits are not driven by the volume of waste material disposed of, but by the total radioactivity content of the material. Existing limits on the concentration of radioactivity in waste media provides protection from small volumes of "hot" or high specific activity materials from being spread on the disposal field.

3.0 METHOD OF EVALUATION

The method of evaluating the impacts from the on-site spreading is the same as used and approved in the original exemption request made to the NRC under 10CFR20.302 for septic waste and which has been applied in all subsequent amendment requests for additional types of earthen materials to be disposed by land spreading on-site. The pathway and dose models found in Regulatory Guide 1.109 (Reference 2) are employed in performing the radiological dose impact assessment. The application of the dose models begins with the characterization of the waste materials that are to be subject to the dose evaluation.

3.1 Waste Characterization

The existing accumulated soil / sand that has created a backlog of accumulated material over the last several years is identified on Table 1, along with the estimated volume and origination of material. The soil materials were primarily derived from excavation activities associated with the construction of new security fences along the plant's Protected Area boundary and the construction of new plant installations associated with the capability to perform hydrogen water chemistry treatment of the plant's coolant system. Also included are road treatment sands used for winter traction inside the protected area.

The soil / sand mix is typical of fill material containing light to dark brown poorly sorted soils with some small stones, and may include small incidental pieces of asphalt. The soil was removed from its original location by shovel, backhoe and front-end loader, and placed into dump trucks for transport to the temporary storage area located between the Cooling Towers where it was deposited on the ground surface and covered to prevent erosion. This location was selected because it was away from areas routinely occupied by plant staff, and could easily be controlled. The most probable source of the low levels of radioactive contamination is due to the presence of below detectable removable contamination redistributed by foot traffic from inside the plant to walkways and parking areas. Subsequent surface runoff carries the contamination to nearby exposed soil near the Protected Area boundary where it accumulates over time to low-level detectable concentrations. Down wash and deposition of particulate activity released from the plant's Primary Vent Stack as part of routine gaseous emissions may also have contributed to the low levels of detectable activity.

For potential future disposal volumes of sand and soil, the current volume limit (1000 ft^3 [28.3 m^3], ODCM Appendix H, Reference 1) was based on the expected rate of road sand used for winter road and walkway traction, but did not anticipate or reflect the potential for future site construction activities that could excavate soils on-site that also contain low levels of plant related radioactivity. The present inventory of stored soil / sand between the Cooling Towers includes approximately 18,653 ft^3 (528 m^3) of material of which only 3.3% or 616 ft^3 (17.4 m^3) originated as roadway sweepings. In accordance with Appendixes B and F of the ODCM, disposal of septic waste and Cooling Tower silt material is not limited by an annual volume limit but by total dose impact related to the radioactivity content of the silt and the concentration of radioactivity contained within it. Currently, only soils / sand mixtures have an annual on-site disposal limit equal to 1000 ft^3 (28.3 m^3).

Table 1
Inventory of Contaminated Soil Piles
In Storage
(December 2003)

Pile description	Overall Length	Overall width	Max Height	Estimated Volume
	ft	ft	inches	ft^3
(1) 2002-01: Security Fence Upgrade	75	21	44	4,679
(2) 2002-02: Security Fence Upgrade	75	28	60	9,000
(3) 2002-03: Security Fence Upgrade	39	22	42	2,457
(4) Sand Sweepings (inside protected area)	16	11	42	616
(5) 2001 HWC Soils Excavation	38	11	42	931
(6) 1996 Soil Remnants from Fence Upgrade	24	6.4	84	970
		total Vol. (ft^3) =		18,653

3.2 Soil Disposal and Administrative Procedure Requirements

The method of soil/sand disposal of the existing backlog inventory will use the technique of land spreading in a manner consistent with the current commitments for the on-site disposal of septic waste and Cooling Tower silts as approved by the NRC and implemented in Appendices B and F of the Vermont Yankee ODCM (Reference1). The accumulation of radioactivity on the disposal plot for this proposed soil spreading operation will be treated as if Cooling Tower silt or septic waste was being disposed of since the characteristics of all these residual solids are similar (earthen-type matter). The South field (approximately 1.9 acres in size) has been used for all past disposal operations and is expected to be used for the placement of the existing backlog (see Table 1 above) of approximately 18,653 ft^3 (528 m^3) of soil and all annual projected future disposals of septic waste, Cooling Tower silt, and low-level contaminated soil volumes through the end of the plant's current operating license (year 2013). Determination of the radiological dose impact has been made based on the same models and pathway assumptions as indicated in Appendix B of the Vermont Yankee ODCM and approved as part of the original disposal analysis application for septic waste.

Both the existing accumulated and future potential soil material will be dispersed using typical agricultural dry bulk surface spreading practices in approved disposal areas on site. Incidental pieces of asphalt and large stones that are picked up with the soil will be screened out before the soil/sand is spread.

Records of the disposal that will be maintained include the following (as prescribed in Reference 1, Appendix B):

(a) the radionuclide concentrations detected in the soil/sand (measured to environmental lower limits of detection)
(b) the total volume of material disposed of
(c) the total radioactivity in the disposal operation as well as the total accumulated on each disposal plot at the time of spreading
(d) the plot on which the soil was applied, and

(e) dose calculations or maximum allowable accumulated activity determinations required to demonstrate that the dose limits imposed on the land spreading operations have not been exceeded.

To ensure that the addition of the soil containing the radioactivity will not exceed the boundary conditions, the total radioactivity and dose calculation will include all past disposal operations of septic waste, Cooling Tower silt and soil/sand decay-corrected to the date of the latest spreading placed on the designated disposal plots. In addition, concentration limits applied to the disposal of earthen type materials (dry soil) restrict the placement of small volumes of materials that have relatively high radioactivity concentrations.

Any farmer leasing land used for the disposal of soil will be notified of the applicable restrictions placed on the site due to the spreading of low level contaminated material. These restrictions are the same as detailed for septic waste spreading as given in Reference 1.

The disposal operation of the soil piles will follow the applicable Vermont Yankee procedures to maintain doses as low as reasonably achievable and within the specific dose criteria as previously approved for septic and Cooling Tower silt waste disposal.

3.3 Disposal Plot Characteristics

All designated disposal sites (six different plots) are located on the Entergy Nuclear Northeast Vermont Yankee plant site and are within the site boundary security fence. The South field consists of approximately 1.9 acres and is centered approximately 1500 feet South of the Reactor Building. This field has been the only one of the NRC approved fields that has actually been utilized for this purpose to-date. It is anticipated that future disposal operations will also utilize the South field since sufficient margin in comparison to the approved dose limit criteria still exists for anticipated waste disposal of the existing backlog of soil now in storage, plus all expected future disposals of septic waste, Cooling Tower silt and soil / sand mixes assuming the same observed generation rates (see Tables 13 through 19) persist to the end of the plant license in 2013.

In addition to the South field, the north end of the site has an additional ten acre parcel centered approximately 2,000 feet northwest of the Reactor Building. Prior assessments have demonstrated that a single plot of about 2 acres is sufficient to meet routine or expected disposal needs. Therefore the northern site could be subdivided into 5 plots if additional capacity was needed.

3.4 Radiological Impact Methodology

The amount of radioactivity added to any of the disposal fields is procedurally controlled to insure that doses are maintained within the prior approved limits of the boundary conditions (see Section 1.0 above).

To assess the dose received (after the spreading of the existing 18,653 ft^3 [528 m^3] along with both past recorded disposal applications, plus projected future applications) by the maximally exposed individual during the period of plant control, and to an inadvertent intruder after plant control of access ends (reference year of 2013), the same pathway modeling, assumptions and dose calculation methods as approved for septic waste, Cooling Tower silt and past soil / sand disposals are used.

These dose models implement the methods and dose conversion factors as provided in Regulatory Guide 1.109 (Reference 2).

The following six potential pathways were identified and included in the analysis:

(a) Standing on contaminated ground,
(b) Inhalation of resuspended radioactivity,
(c) Ingestion of leafy vegetables,
(d) Ingestion of stored vegetables,
(e) Ingestion of meat, and
(f) Ingestion of cow's milk

Both the maximum individual and inadvertent intruder are assumed to be exposed to these pathways, with the difference between them being the occupancy time. The basic assumptions used in the radiological analyses include:

(a) Direct exposure to ground contamination and inhalation of resuspended radioactivity from the ground by movement of air is for a period of 104 hours per year during the Vermont Yankee active control of the disposal sites and continuous thereafter. The 104-hour interval is representative of a farmer's time spent on a plot of land (4 hours per week for 6 months). The resuspension factor for soil material on the ground back into the air is taken as 1.0E-05 based on an assumption that the disposal field will display characteristics similar to semiarid grassland experimental results. [NUREG-75/014; WASH-1400,"Reactor Safety Study", Appendix VI, Table VI E-3; USNRC, October 1975]

(b) For the purpose of projecting and illustrating the magnitude of dose impacts over the remaining life of the plant, it is assumed that future disposals of septic, silt and soil material will be placed annually on the same field at the annual average radioactivity levels observed for these waste streams over the past fourteen years. The future disposals will also consist of the annual average radioactivity content observed in the accumulated soil/sand materials collected over the last several years that involved site facility construction projects that has lead to the existing backlog. The maximum individual dose impact from the buildup of disposed material occurs at the same time (2013) for both the Control Period and Intruder scenarios.

(c) For the analysis of the radiological impact during the Vermont Yankee active control of the disposal sites until 2013, no plowing is assumed to take place and all dispersed radioactive material remains on the surface forming a source of unshielded direct radiation.

(d) The crop exposure time was changed from 2160 hours to 0 hours to reflect the condition that no radioactive material is dispersed directly on crops for human or animal consumption. Crop contamination is only through root uptake.

(e) The deposition on crops of resuspended radioactivity is insignificant.

(f) Most of the pathway data and usage factors used in the analysis are the same as those used in the Vermont Yankee's ODCM assessment of off-site radiological impacts from routine releases. The fraction of stored vegetables grown on the contaminated land was conservatively increased from 0.76 to 1.0 (at present no vegetable crops for human consumption are grown on any of the approved disposal plots). Also, the soil exposure time to account for buildup was changed from the standard 15 years (given in Reference 2) to 1 year.

(g) It is conservatively assumed that Vermont Yankee relinquishes control of the disposal sites after the current operating license expires in 2013 (i.e., the source term accumulated on a single disposal plot applies also for the inadvertent intruder at that time).

(h) For the analysis of the impact after Vermont Yankee control of the site is relinquished, the radioactive material is plowed under and forms a uniform mix with the top six inches of the soil, but, nonetheless, undergoes resuspension in the air at the same rate as the unplowed surface contamination. However, for direct ground plane exposure the self-shielding due to the six-inch plow layer reduces the surface dose rate by about a factor of four.

As shown in Reference 1 (Appendix B) for the original analysis in septic waste, the liquid transport and exposure pathway was found to be an insignificant contributor to the dose. Restrictions on the placement of the disposal plots put them at significant distances from wet lands, potable well supplies, and surface waters (Connecticut River). Therefore, the liquid pathway is not considered in this analysis.

The dose models and methods used to generate deposition values and accumulated activity over the operating life of the plant are documented in Reference 1 (Appendixes B and F). Table 18 presents the radioactivity that currently exists on the South field after the last spreading event, which occurred on November 4, 2003. Table 18 also indicates the residual radioactivity that would remain on South field at the end of the plant operating period (2013) if no additional disposals were to take place.

4.0 ASSUMPTIONS AND INPUTS

1) The volume of the accumulated soil / sand currently in storage between the Cooling Towers (as of December, 2003) was estimated from field measurements of length, width, height and general shape of each pile taken in 2003. The estimated volume of each pile is summarized on Table 1.
2) The radioactivity content of each pile was determined by averaging the numerious grab samples (typically 30 samples per pile) collected for characterization of the soil material collected. Appendixes A through F provide the individual results of positive analysis for plant related radionuclides. Laboratory analyses were performed either by Vermont Yankee or the AREVA-Framatome (formerly the Yankee Atomic / Duke Engineering) Environmental laboratory with samples counted with respect to the NRC environmental LLD requirements as indicated in the VY ODCM.
3) Appendix G provides the total accumulated radioactivity on the South disposal Plot (1.9 acres) decayed to the date of the last spreading of waste materials of November 4, 2003.
4) Dose Conversion Factors (DCF) specific to the land spreading of materials at Vermont Yankee were taken from the VY ODCM, Appendix F, Tables 11 and 12 (Reference 1). These DCF's were based on the same dosimetric models and input parameters as used in the original analysis of septic waste spreading at VY and which was approved by the NRC for inclusion in the ODCM as Appendix B. Section 3.2 of this calculation provides an outline of the key aspects of the dose model and assumptions used. The following (Tables 2 & 3) listing notes these site specific dose conversion factors for both the Control Period and the Intruder scenario for the nuclides detected as positive in one or more of the sample analyses.

Table 2
Site Specific Control Period Dose Conversion Factors

Isotope	Individual/Organ	Max Organ DCF Control (mrem/yr-µCi/acre)	Whole Body DCF Control (mrem/yr-µCi/acre)	Half-Life days	Decay Constant (λ) Yr-1
Mn-54	Adult/GI-LLI	3.75E-04	1.93E-04	3.125E+02	8.113E-01
Co-60	Teen/Lung	7.17E-04	5.31E-04	1.925E+03	1.315E-01
Zn-65	Child/Liver	1.64E-02	1.03E-02	2.438E+02	1.038E+00
Cs-134	Child/Liver	3.18E-03	1.28E-03	7.531E+02	3.356E-01
Cs-137	Child/Bone	2.66E-03	7.02E-04	1.102E+04	2.290E-02
Ce-141	Teen/Lung	1.54E-04	1.50E-05	3.250E+01	7.788E+00
Ce-144	Teen/Lung	6.00E-04	2.44E-05	284.6	8.888E-01

Table 3
Site Specific Intruder Dose Conversion Factors

Isotope		Max Organ DCF Intruder (mrem/yr-µCi/acre)	Whole Body DCF Intruder (mrem/yr-µCi/acre)
Mn-54	Teen/Lung	1.02E-02	3.12E-03
Co-60	Teen/Lung	3.19E-02	9.09E-03
Zn-65	Child/Liver	1.89E-02	1.25E-02
Cs-134	Child/Liver	1.21E-02	9.36E-03
Cs-137	Child/Bone	6.98E-03	3.85E-03
Ce-141	Teen/Lung	1.21E-02	3.44E-04
Ce-144	Teen/Lung	5.00E-02	1.52E-03

5.0 EVALUATIONS

In order to demonstrate compliance with the boundary dose conditions as stated in the ODCM, the critical organ and whole body dose from all pathways to the maximally exposed individual during Vermont Yankee Control Period and to the Inadvertent Intruder (for time periods following the end of the current operating plant license scheduled for 2013) were calculated for several scenarios (case studies) or combinations of disposal options. The dose calculations were performed using the site-specific dose factors for detected radionuclides as presented in Tables 2 and 3 (obtain from the VY ODCM, Appendix F, Tables 11 and 12). The objective is to demonstrate that the addition of the existing soil/sand materials currently in storage will not cause the radiological dose limits for materials spread on the South disposal field to be exceeded, even if it is assumed that all projected future annual disposals of septic waste, cooling tower silt and excavated soils/roadway sand containing the observed historical levels of plant related radionuclides are also placed on the same disposal plot.

5.1 Case Study I (Past Spreading Impacts)

The first case study (Case I) evaluated the spreading related dose impact associated with the past septic, Cooling Tower silt and soil spreading activity only. Table 4 shows the annual history and total amount of radioactivity in septic, silt and soil/sand waste materials by radionuclide that has been spread on the South field for the past 14 years (last spreading on 11/4/03). These radioactivity disposal values were taken from the past spreading records. Using (multiplying) the dose conversion factors listed on Tables 2 and 3 along with the total accumulated radioactivity content on the South disposal plot as of the last waste spreading in 2003 as shown on Table 18, the committed dose impact is found on Tables 21 and 22 for the Control Period dose as of the last spreading on November 4, 2003, as well as the Intruder Dose projected to 2013 from all materials currently spread on the South disposal plot. This assessment assumes no other material is spread on the disposal plot in the future, and therefore represents the existing dose commitments from all past spreadings. This establishes the dose margin in comparison to the Control Period and Intruder dose limits still available for the South disposal plot.

5.2 Case Study II (Stored Soil/Sand Inventory Impacts)

The second case study (Case II) looks at the spreading dose impact (Control Period and the Intruder impact at the end of plant license) first from the radioactivity associated with the existing soil in storage (18,653 ft^3 as indicated on Table 1) between the Cooling Towers, and then in combination with all past spreadings in order to demonstrate that the single south disposal plot can accommodate the current backlog of soil now being stored if it were all spread on top of all past disposals.

Table 18 indicates the total accumulated septic, silt and soil activity per radionuclide remaining on the disposal plot as of the last spreading (11/04/03), as well as decayed to the projected reference date (6/1/04) for the spreading of all existing soil being held in storage, and to the projected end of the current plant license in 2013.

Tables 8, 9, 10 and 11 provide the estimate of radioactivity content in each of the storage piles of soil/sand being held between the Cooling Towers for the detected nuclides Cs-137, Co-60, Zn-65, and Mn-54, respectively. The activity concentrations are based on multiple grab samples collected

from each of the six separate storage piles, and are taken from the grab sample laboratory radiological analyses for each of the storage piles provided in Appendixes A through F. The average Cs-137 concentration in each of the soil piles was determined by including in the average the minimum detectable concentration (MDC) of each radionuclide because most of the samples indicated a positive concentration for Cs-137. This slightly biases the assessment towards a conservative upper bound estimate of the potential activity in the pile since the use of the MDC does not represent the existence of positive measured activity in the sample, but is treated as such. For the other detected radionuclides (Co-60, Zn-65 and Mn-54), this biasing of the data was not applied since the occurrence of positive values only represented a small fraction of the total number of samples taken. The total activity determination for each pile is then calculated by taking the average measured concentration times the measured soil density times the estimated volume of the storage pile, correcting for decay time between the date of the sample analysis date to the estimated date of field disposal (6/1/04). This calculated total radionuclide activity value for each pile is assumed to be placed on the single 1.9 acre South disposal plot with the resulting surface concentration (uCi/acre) for the projected disposal calculated for each pile and totaled for all six piles currently in storage. The estimated average concentration for each of the four detected radionuclides is decay corrected from the date of the sample collection to June 1, 2004, as the reference date for estimating dose impacts from the proposed disposal of the accumulated material in storage. Table 12 summarizes the radioactivity associated with the soil/sand in storage decayed to June 1, 2004, and to the estimated end of the current plant license in 2013 for determining the Intruder dose impact at that time. Table 20 combines the radioactivity content of all soil/sand materials stored between the Cooling Towers with all remaining activity previously spread on the South disposal plot, decayed to 2013 for use in determining the Intruder dose at the end of plant license.

Table 23 applies the dose conversion factors from Table 2 for maximum organ and whole body doses with the projected activity on the South disposal plot from Tables 12, 18 and 20 to find the Control Period dose for all past material spreadings, stored material additions, and the sum total of past spreadings and proposed stored material additions. Table 24 illustrates the same dose impact combination of waste streams as applied to the site Intruder at the end of plant license. The combination of all past spreadings and the current stored soil material results in a maximum organ dose of only 17.7 % (0.177 mrem/yr) of the 1 mrem/yr Control Period dose limit. The maximum Intruder organ dose is estimated to be 0.456 mrem/yr or 9.1% of the 5 mrem/yr Intruder scenario dose limit. For comparison, Table 25 indicates that the maximum organ dose during the Control Period from only the inventory of 18,653 ft^3 of soil/sand is estimated to be 0.0526 mrem/yr, or 5.3% of the 1 mrem/yr dose limit.

5.3 Case Study III (Projected Future Spreading Impacts)

The third case study (Case III) projects what the likely annual spreading additions of earthen material from all sources (septic waste, Cooling Tower silt, soil/sand mixes) would be based on historical records, combined with the existing 18,653 ft^3 (528 m^3) of material in storage, in order to determine the long term acceptability of the South disposal plot to continue to be used for all waste spreading applications.

Based on the historical spreading data listed in Table 4, Tables 5, 6 and 7 show the total accumulated septic waste, Cooling Tower silt and soil/sand annual average field spreading surface concentrations by radionuclide and waste source, respectively. This data breakdown is used in this disposal case study to predict future disposal rates to be applied to the South disposal plot. Table 13 provides a

summary of the buildup of future spreadings over time after 2004 from all three waste streams (Septic waste, Cooling Tower silt, and soil/sand mixes), which could be projected to accumulate on the South disposal plot by 2013. The annual disposal quantity for each waste stream is based on the average annual disposal quantity observed for each stream since on-site disposal was originally approved in 1990. The total of all three streams (septic waste, Cooling Tower silt, and soil/sand) is taken to be representative of the future generation rate for each year from 2004 until 2013. The last column of Table 13 indicates the decay corrected accumulated activity on the South disposal plot from only additions to the South field from all future waste earthen materials. Tables 14, 15 and 16 provide additional detail of the projected annual and accumulated materials by waste stream (i.e., sand/soil mix, Cooling Tower silt and septic waste). The buildup equation used in Tables 13 through 18 accounts for both annual additions to the field as well as decay over this in-growth period is given by:

$$Act_i(t) = Act_i(a) * (1 - E^{[t-1]})/(1 - E)$$

Where:

$Act_i(t)$ = the total activity of radionuclide "i" (uCi) remaining at the end of the buildup period, t (years).

$Act_i(a)$ = the annual radioactivity addition of nuclide "i" to the disposal plot in uCi. The values for projected future additions are based on the annual average value observed for that nuclide for the specific disposal stream (i.e., septic waste, cooling tower slit, soil/sand).

E = $\exp(-\lambda_i \Delta t)$

λ_i = is the decay constant for the selected radionuclide "i" (1/year)

Δt = time interval between applications = 1 year.

In addition, Case Study II above evaluated the radiological impact from the disposal of the existing inventory of soil projected for mid-year, 2004 (including all past waste spreading operations), the total impact for 2004 should also include a projected disposal of both septic waste and Cooling Tower silt from one year's operation. Table 17 combines one year's generation of both septage and silt for assumed spreading in 2004, plus subsequent decay to 2013.

Table 26 combines the site-specific dose conversion factors from Tables 2 and 3 for the Control Period and Intruder scenario, respectively, with all previously spread radioactivity on the South disposal plot (Table 18) with both the proposed disposal of the existing soil stored inventory (Table 12) and projected annual additions of earth type waste materials based on the observed average annual generation rate (Tables 13 through 17). Table 19 provides a summary of accumulated radioactivity on the South field from the past spreading, materials in storage and future annual disposals on the same plot out to the assumed end of plant license, which corresponds to the Intruder dose scenario time frame. The resulting doses to the maximum organ and whole body of the maximum individual at the end of plant license (Table 26) reflects the maximum expected impact from all past and future disposals being placed on the South disposal field.

6.0 RESULTS / CONCLUSIONS

The evaluation of the radiological impact of all past, accumulated storage inventory, and projected future waste spreading operations on the 1.9 acre South disposal plot have shown that the existing field is being operated within the previously approved dose limit criteria. The specific findings include:

1. For Case Study I (Past Spreading Impacts), Table 21 shows that after 14 years of spreading septic waste, Cooling Tower silt, and soil/sand mixes on the a single, 1.9 acre disposal plot the committed dose impact results in a maximum organ dose to a critical receptor (Control Period use) that accounts for only 13.7% of the 1 mrem/year limit. With respect to the Intruder dose limit of 5 mrem/year at the end of assumed active property control (i.e., end of plant license assumed for dose projection purposes), Table 22 indicates that all past spreadings through the end of 2003 account for only 7.2% of the maximum organ dose to the limiting receptor at the end of plant license. These finding illustrate that there is significant capacity remaining in the South disposal plot to continue to accept additional earthen materials that are suitable for land spreading without exceeding established dose limitations.

2. Table 23 shows that the impact from the projected spreading of the existing 18,653 ft^3 of soil/sand material in storage is estimated to account for only 5.3% of the 1 mrem/year Control Period dose limit, or only 17.7% of the same limit when all past spreadings are combined with the materials currently in storage (as of the end of November 2003). The maximum Intruder organ dose from all past spreading and stored materials is calculated to be 0.456 mrem/yr (Table 24), or 9.1% of the 5 mrem/yr Intruder scenario dose limit. These results indicate that the existing inventory of waste materials in storage can be placed on the South disposal plot without exceeding dose impact limits previously established for a single disposal field, or using a significant proportion of the South disposal plot's capacity to receive additional materials for disposal in the future.

3. Assuming the same annual average generation rate of radioactivity in waste materials (septage/silt/soil) that has been observed over the last 14 years is added each year through 2013 to all past waste spreadings (including the stored soils inventory) already committed to the South disposal plot, Table 26 indicates that the projected dose at the end of the current plant licensing period (year 2013) yields a limiting maximum critical receptor dose (for either the control period or inadvertent intruder) equivalent to only 25.3% of the most restrictive annual dose limit (associated with the 1 mrem/year limit for the maximum organ during the Control Period). This finding demonstrates that the continued use of the South disposal plot, even with the addition of 18,653 ft^3 of slightly contaminated soil currently in storage, will not exceed the approved limiting dose criteria established in the ODCM.

4. The approved dose impact methodology used to determine compliance with the on-site spreading dose limits are not driven by the volume of waste material disposed of, but by the total radioactivity content of the material that is spread over a fixed disposal plot area (1.9 acres for the South field). The dose modeling assumes that all radioactivity spread on the field remains in the top 15 cm surface layer of soil, even after subsequent additions are

placed on the same field area. Existing limits on the concentration of radioactivity in waste media provides protection from small volumes of "hot" or high specific activity materials from being spread on the disposal field.

Table 4

Record of Septic / Cooling Tower Silt / Construction Soil Radioactive Material Spreading
Each Year on the South Disposal Field

Year	Spreading Date	Material Type	Mn-54 (uCi/acre)	Co-60 (uCi/acre)	Zn-65 (uCi/acre)	Cs-134 (uCi/acre)	Cs-137 (uCi/acre)	Ce-141 (uCi/acre)
1990	10/31/90	Septage	0	3.89	0	0	0.26	0
	11/20/90	Septage	0.17	2.03	0.41	0	0.29	1.40E-08
1991		none	0	0	0	0	0	0
1992	10/19/92	Septage	0.11	1.73	0.52	0.05	0.32	0.006
1993	10/14/93	Septage	0.05	1.41	0.21	0	0.3	0
1994	06/14/94	Septage	0.08	0.43	0	0	0.09	0
1995	06/29/95	Septage	0	0.88	0	0	0	0
1996		none	0	0	0	0	0	0
1997	06/18/97	Septage	0.12	1	0	0	0.19	0
1998	07/30/98	Septage	0.14	0.72	0.09	0	0.12	0
	09/18/98	CT Silt	0	0	0	0	30.87	0
1999	07/15/99	Septage	0.11	1.47	0.2	0	0.25	0
2000	08/09/00	Septage*	0	0	0	0	0	0
	10/24/00	CT Silt	0.117	0.68	0	0	0	0
	10/24/00	Soil/Sand	0	0.602	0	0	3.698	0
2001	06-20-01	Septage	0	4.078	1.088	0	0.156	0.089
	09/25/01	Soil/Sand	0	0	0	0	1.4	0
2002	06/21/02	Septage	0.01	0.04	0	0.001	0.01	0
	11/11/02	Soil/Sand	0	0	0	0	1.37	0
2003	07/01/03	Septage	0	1.03	0	0	0	0
	10/25/03	Septage	0	0.12	0	0	0	0
	11/04/03	Soil/Sand	0	0	0	0	1.34	0
	11/04/03	CT Silt	0	0.256	0	0	0	0
Average Activity/yr (uCi/acre): (Over 14 year spreading history)			0.06	1.45	0.18	0.0036	2.90	0.01
Average activity (uCi/yr) disposed of on 1.9 acre field each year			0.123	2.76	0.342	0.007	5.52	0.013

* No radioactivity detected in septic waste samples.

Table 5

Record of Septic Waste Only for Radioactive Material Spreading
Each Year on the South Disposal Field

Year	Spreading Date	Material Type	Mn-54 (uCi/acre)	Co-60 (uCi/acre)	Zn-65 (uCi/acre)	Cs-134 (uCi/acre)	Cs-137 (uCi/acre)	Ce-141 (uCi/acre)
1990	10/31/90	Septage	0	3.89	0	0	0.26	0
	11/20/90	Septage	0.17	2.03	0.41	0	0.29	1.40E-08
1991		none	0	0	0	0	0	0
1992	10/19/92	Septage	0.11	1.73	0.52	0.05	0.32	0.006
1993	10/14/93	Septage	0.05	1.41	0.21	0	0.3	0
1994	06/14/94	Septage	0.08	0.43	0	0	0.09	0
1995	06/29/95	Septage	0	0.88	0	0	0	0
1996		none	0	0	0	0	0	0
1997	06/18/97	Septage	0.12	1	0	0	0.19	0
1998	07/30/98	Septage	0.14	0.72	0.09	0	0.12	0
1999	07/15/99	Septage	0.11	1.47	0.2	0	0.25	0
2000	08/09/00	Septage*	0	0	0	0	0	0
2001	06-20-01	Septage	0	4.078	1.088	0	0.156	0.089
2002	06/21/02	Septage	0.01	0.04	0	0.001	0.01	0
2003	07/01/03	Septage	0	1.03	0	0	0	0
	10/25/03	Septage	0	0.12	0	0	0	0
Average Activity/yr (uCi/acre): (Over 14 year spreading history)			0.06	1.34	0.18	0.004	0.14	0.01
Average activity (uCi/yr) disposed of on 1.9 acre field each year			0.107	2.56	0.342	0.007	0.27	0.013

* No radioactivity detected in septic waste samples.

Table 6

Record of Cooling Tower Silt Waste Only for Radioactive Material Spreading
Each Year on the South Disposal Field

Year	Spreading Date	Material Type	Mn-54 (uCi/acre)	Co-60 (uCi/acre)	Zn-65 (uCi/acre)	Cs-134 (uCi/acre)	Cs-137 (uCi/acre)	Ce-141 (uCi/acre)
1998	09/18/98	Silt	0	0	0	0	30.87	0
2000	10/24/00	Silt	0.117	0.68	0	0	0	0
2003	11/04/03	Silt	0	0.256	0	0	0	0
Average Activity/yr (uCi/acre) (31 year silt generation history)			0.004	0.030	0.000	0.000	0.996	0.000
Average activity (uCi/yr) disposed of on 1.9 acre field			0.007	0.057	0.000	0.000	1.892	0.000

Note: Cooling Tower yearly average is over 31 years of operation since the first disposal in 1998 included all accumulated material since plant startup

Table 7

Record of Construction Soil/Sand Waste Only for Radioactive Material Spreading
Each Year on the South Disposal Field

Year	Spreading Date	Material Type	Mn-54 (uCi/acre)	Co-60 (uCi/acre)	Zn-65 (uCi/acre)	Cs-134 (uCi/acre)	Cs-137 (uCi/acre)	Ce-141 (uCi/acre)
2000	10/24/00	Soil/Sand	0	0.602	0	0	3.698	0
2001	09/25/01	Soil/Sand	0	0	0	0	1.4	0
2002	11/11/02	Soil/Sand	0	0	0	0	1.37	0
2003	11/04/03	Soil/Sand	0	0	0	0	1.34	0
Average Activity/yr (uCi/acre):			0.00	0.15	0.00	0.00	1.95	0.00
Average activity (uCi/yr) disposed of on 1.9 acre field per year			0.00	0.29	0.00	0.00	3.71	0.00

Note: Soil/ road sand yearly average is over only the 4 years of operation since that is the period of material collection.

Table 8

Cesium -137 in storage Piles after Last Spreading 2003* Activity decayed to 06/01/04

Pile description	Estimated Volume	Date of Analysis	Decay time to 6/1/04	Aver. Cs-137 Conc.(w /LLD) No decay	Measured density	Total Cs-137 (decayed) (w /LLD)	Aver. Cs-137 Conc.(w/ LLD) decayed	Cs-137 applied to 1.9 acre field	% Cs-137 of total
	ft^3		years	uCi/gm	gm/cc	uCi	uCi/gm	uCi/acre	
2002-01: Security Fence Upgrade	4,679	05/06/02	2.08	7.12E-08	1.07	9.62E+00	6.79E-08	5.07E+00	31.48%
2002-02: Security Fence Upgrade	9,000	06/04/02	2.00	4.18E-08	1.11	1.13E+01	3.99E-08	5.94E+00	36.95%
Park Lot Sweep (inside protected area)	616	11/02/01	2.58	4.80E-08	1.56	1.23E+00	4.52E-08	6.48E-01	4.03%
2001 HWC Soils Excavation	931	10/22/01	2.58	5.41E-08	1.057	1.42E+00	5.10E-08	7.48E-01	4.65%
1996 Remnants(mixed contam. + non-cont)	970	04/13/95	8.13	9.22E-08	1.7	3.57E+00	7.65E-08	1.88E+00	11.69%
2002-03 Security Fence Chunks & soil mix	2,457	12/16/02	1.54	4.11E-08	1.24	3.42E+00	3.97E-08	1.80E+00	11.20%
totals =	18,653		Average =	5.81E-08	total =	3.06E+01	5.34E-08	1.61E+01	100.00%

* Note: Soil analysis data provided in Appendixes A through F.

Table 9

Cobalt -60 in Storage Piles after Last Spreading in 2003* Activity decayed to 06/01/04

Pile description	Estimated Volume	Date of Analysis	Decay time to 6/1/04	Aver.Co-60 Conc., no decay	Measured density	Total Co-60 (decayed)	Aver. Co-60 Conc., decayed	Co-60 applied to 1.9 acre field	% Co-60 of total
	ft^3		years	uCi/gm	gm/cc	uCi	uCi/gm	uCi/acre	
2002-01: Security Fence Upgrade	4,679	05/06/02	2.08	0.00E+00	1.07	0.00E+00	0.00E+00	0.00E+00	0.00%
2002-02: Security Fence Upgrade	9,000	06/04/02	2.00	0.00E+00	1.11	0.00E+00	0.00E+00	0.00E+00	0.00%
Park Lot Sweep (inside protected area)	616	11/02/01	2.58	8.72E-09	1.56	1.69E-01	8.22E-09	8.90E-02	33.01%
2001 HWC Soils Excavation	931	10/22/01	2.58	0.00E+00	1.057	0.00E+00	0.00E+00	0.00E+00	0.00%
1996 Remnants(mixed contam. + non-cont)	970	04/13/95	8.13	2.14E-08	1.7	3.43E-01	1.78E-08	1.81E-01	66.99%
2002-03 Security Fence Chunks & soil mix	2,457	12/16/02	1.54	0.00E+00	1.24	0.00E+00	0.00E+00	0.00E+00	0.00%
totals =	18,653		average =	5.02E-09	total =	5.12E-01	4.33E-09	2.70E-01	100.00%

* Note: Soil analysis data provided in Appendixes A through F.

Table 10

Zinc -65 in Storage Piles after Last Spreading in 2003* Activity decayed to 06/01/04

Pile description	Estimated Volume	Date of Analysis	Decay time to 6/1/04	Aver. Zn-65 Conc., no decay	Measured density	Total Zn-65 (decayed)	Aver. Zn-65 Conc., decayed	Zn-65 applied to 1.9 acre field	% Zn-65 of total
	ft^3		years	uCi/gm	gm/cc	uCi	uCi/gm	uCi/acre	
2002-01: Security Fence Upgrade	4,679	05/06/02	2.08	0.00E+00	1.07	0.00E+00	0.00E+00	0.00E+00	0.00%
2002-02: Security Fence Upgrade	9,000	06/04/02	2.00	3.87E-09	1.11	1.05E+00	3.70E-09	5.50E-01	95.04%
Park Lot Sweep (inside protected area)	616	11/02/01	2.58	0.00E+00	1.56	0.00E+00	0.00E+00	0.00E+00	0.00%
2001 HWC Soils Excavation	931	10/22/01	2.58	2.08E-09	1.057	5.46E-02	1.96E-09	2.87E-02	4.96%
1996 Remnants(mixed contam. + non-cont)	970	04/13/95	8.13	0.00E+00	1.7	0.00E+00	0.00E+00	0.00E+00	0.00%
2002-03 Security Fence Chunks & soil mix	2,457	12/16/02	1.54	0.00E+00	1.24	0.00E+00	0.00E+00	0.00E+00	0.00%
totals =	18,653		Average =	9.92E-10	total =	1.10E+00	9.43E-10	5.79E-01	100.00%

* Note: Soil analysis data provided in Appendixes A through F.

Table 11

Pile description	Estimated Volume	Date of Analysis	Decay time to 6/1/04	Aver. Mn-54 Conc., no decay	Measured density	Total Mn-54 (decayed)	Aver. Mn-54 Conc., decayed	Mn-54 applied to 1.9 acre field	% Mn-54 of total
	Mn-54 in Storage Piles after Last Spreading in 2003*					Activity decayed to 06/01/04			
	ft^3		years	uCi/gm	gm/cc	uCi	uCi/gm	uCi/acre	
2002-01: Security Fence Upgrade	4,679	05/06/02	2.08	2.09E-09	1.07	2.82E-01	1.99E-09	1.49E-01	69.78%
2002-02: Security Fence Upgrade	9,000	06/04/02	2.00	0.00E+00	1.11	0.00E+00	0.00E+00	0.00E+00	0.00%
Park Lot Sweep (inside protected area)	616	11/02/01	2.58	4.77E-09	1.56	1.22E-01	4.50E-09	6.44E-02	30.22%
2001 HWC Soils Excavation	931	10/22/01	2.58	0.00E+00	1.057	0.00E+00	0.00E+00	0.00E+00	0.00%
1996 Remnants (mixed contam. + non-cont)	970	04/13/95	8.13	0.00E+00	1.7	0.00E+00	0.00E+00	0.00E+00	0.00%
2002-03 Security Fence Chunks & soil mix	2,457	12/16/02	1.54	0.00E+00	1.24	0.00E+00	0.00E+00	0.00E+00	0.00%
totals =	18,653		Average=	1.14E-09	total =	4.05E-01	1.08E-09	2.13E-01	100.00%

* Note: Soil analysis data provided in Appendixes A through F.

Table 12

Soil/Sand in Storage Total Activity to be spread on 6/1/04 and decayed to 2013

Isotope	lamda 1/yr	As of 6/1/04 Qa (uCi/acre)*	Decay Time to 6/1/2013 (yrs)	As of 2013 Qa (uCi/acre)
Mn-54	0.8113	0.213	9	1.44E-04
Co-60	0.1315	0.270	9	8.27E-02
Zn-65	1.0382	0.579	9	5.07E-05
Cs-134	0.3356	0.000	9	0.00E+00
Cs137	0.0229	16.1	9	1.31E+01
Ce-141	7.7883	0.000	9	0.00E+00

* Note: Qa values from Table 8 (Cs-137), Table 9 (Co-60), Table 10 (Zn-65), and Table 11 (Mn-54)

Table 13

Projection of Additional Septic, silt, and soil/sand at Current Generation Rates to 2013

Isotope	lamda 1/yr	Annual Septic Addition Qa (uCi/acre)	Annual Silt Addition Qa (uCi/acre)	Annual Soil/Sand Addition Qa (uCi/acre)	Annual Total Additions Qa (uCi/acre)	Additional Accumulation at end of 9 years Qe (uCi/acre)
Mn-54	0.8113	0.056	0.0038	0.043	0.103	0.185
Co-60	0.1315	1.345	0.0302	0.174	1.549	8.183
Zn-65	1.0382	0.180	0.0000	0.116	0.296	0.458
Cs-134	0.3356	0.004	0.0000	0.000	0.004	0.012
Cs137	0.0229	0.142	0.9958	4.782	5.919	43.767
Ce-141	7.7883	0.007	0.0000	0.000	0.007	0.007

Table 14
Projection of Additional Sand/Soil Mix
At Historical Generation Rates To Year 2013 (9 years after 2004)

Isotope	lamda 1/yr	Projected Annual Soil/Sand Additions to Field Qa (uCi/acre)	Accumulated Sand/Soil at end of 9 years Qe (uCi/acre)
Mn-54	0.8113	4.26E-02	7.65E-02
Co-60	0.1315	1.74E-01	9.21E-01
Zn-65	1.0382	1.16E-01	1.79E-01
Cs-134	0.3356	0.00E+00	0.00E+00
Cs137	0.0229	4.78E+00	3.54E+01
Ce-141	7.7883	0.00E+00	0.00E+00

Table 15
Projection of Additional Cooling Tower (CT) Silt
At Historical Generation Rates To Year 2013 (9 years after 2004)

Isotope	lamda 1/yr	Projected Annual CT Silt Additions to Field Qa (uCi/acre)	Accumulated CT Silt at end of 9 years Qe (uCi/acre)
Mn-54	0.8113	3.77E-03	6.78E-03
Co-60	0.1315	3.02E-02	1.59E-01
Zn-65	1.0382	0.00E+00	0.00E+00
Cs-134	0.3356	0.00E+00	0.00E+00
Cs137	0.0229	9.96E-01	7.36E+00
Ce-141	7.7883	0.00E+00	0.00E+00

Table 16
Projection of Additional Septic Waste
At Historical Generation Rates To Year 2013 (9 years after 2004)

Isotope	lamda 1/yr	Projected Annual Septic Additions to Field Qa (uCi/acre)	Accumulated Septic Waste at end of 9 years Qe (uCi/acre)
Mn-54	0.8113	5.64E-02	1.01E-01
Co-60	0.1315	1.34E+00	7.10E+00
Zn-65	1.0382	1.80E-01	2.78E-01
Cs-134	0.3356	3.64E-03	1.19E-02
Cs137	0.0229	1.42E-01	1.05E+00
Ce-141	7.7883	6.79E-03	6.79E-03

Table 17

Projected 1 Yr Septage + Silt Spreading for 6/1/04 and decayed to 2013

Isotope	lamda 1/yr	As of 6/1/04 Qa (uCi/acre)	Decay Time to 6/1/2013	As of 2013 Qa (uCi/acre)
Mn-54	0.8113	0.060	9	4.06E-05
Co-60	0.1315	1.375	9	4.21E-01
Zn-65	1.0382	0.180	9	1.57E-05
Cs-134	0.3356	0.004	9	1.78E-04
Cs137	0.0229	1.138	9	9.26E-01
Ce-141	7.7883	0.007	9	2.45E-33

Table 18

Current Total Spreadings as of 11/4/03 and How much Remains at 6/1/04 and 2013

Isotope	lamda 1/yr	As of 11/4/03 Qa (uCi/acre)*	Decay Time to 6/1/04 (yrs)	As of 6/1/04 Qa (uCi/acre)	Decay Time to 2013 (yrs)	As of 2013 Qa (uCi/acre)
Mn-54	0.8113	0.241	0.5753	0.151	9	1.02E-04
Co-60	0.1315	16.33	0.5753	15.140	9	4.64
Zn-65	1.0382	1.47	0.5753	0.809	9	7.08E-05
Cs-134	0.3356	0.00063	0.5753	0.001	9	2.53E-05
Cs137	0.0229	38.18	0.5753	37.68	9	30.66
Ce-141	7.7883	8.80E-10	0.5753	1.0E-11	9	3.60E-42

* Data Taken from Plant Disposal Records

Table 19

Current Spreading Totals Plus Total Projected Future Spreadings to 2013

	Current Field Act. Decayed to 2013*	Stored Soil/sand Decayed to 2013**	1 Yr Septage+silt Decayed to 2013***	All Future Spreading Decayed to 2013****	Total all Activity Decayed to 2013
Isotope	(uCi/acre)	(uCi/acre)	(uCi/acre)	(uCi/acre)	(uCi/acre)
Mn-54	1.02E-04	1.44E-04	4.06E-05	0.185	1.85E-01
Co-60	4.636	8.27E-02	0.421	8.183	1.33E+01
Zn-65	7.08E-05	5.07E-05	1.57E-05	0.458	4.58E-01
Cs-134	2.53E-05	0.00E+00	1.78E-04	0.012	1.21E-02
Cs137	30.66	13.10	0.926	43.767	8.85E+01
Ce-141	3.60E-42	0.00E+00	2.45E-33	0.007	6.79E-03

Notes: * Activity Concentration from Table 18.
** Activity Concentration from Table 12.
*** Activity Concentration from Table 15, 16 and 17.
**** Activity Concentration from Table 13 and 14.

Table 20

Radioactivity Content from Existing Materials (Past Spreadings & Stored Materials Only)

End Plant Operations for Intruder Dose: End Date	6/1/2013	Last Application Date	6/1/2004
Decay duration to end of Plant Operations:	9 years		

Isotope	Total Activity on South Field plus storage piles (uCi/acre)* (6/1/04)	Total Activity decayed to year 2013 (uCi/acre)	Past Material Spread only up to 11/4/03 decayed to 2013 (uCi/acre)	Stored Material to be Spread decayed to 2013 (uCi/acre)	Total Past + Current Material decayed to 2013 (uCi/acre)
Mn-54	0.364	2.46E-04	1.02E-04	1.44E-04	2.46E-04
Co-60	15.41	4.72E+00	4.64E+00	8.27E-02	4.72E+00
Zn-65	1.388	1.21E-04	7.08E-05	5.07E-05	1.21E-04
Cs-134	0.001	2.53E-05	2.53E-05	0.00E+00	2.53E-05
Cs-137	53.78	4.38E+01	3.06E+01	1.31E+01	4.38E+01
Ce-141	1.0E-11	3.60E-42	3.60E-42	0.00E+00	3.60E-42

** Includes all material spread as of 11/4/03 decay corrected to the indicated date.*

Table 21
Past Spreading Control Period Doses
As of 11/04/03
(No Stored Material or Future Additions Included)

Isotope	Total Activity Remaining on South Field as of 11/04/03 uCi/acre	Max Organ Existing Material from Past Spreading Mrem/year	Whole Body Existing Material from Past Spreading Mrem/year
Mn-54	0.241	9.04E-05	4.65E-05
Co-60	16.33	1.17E-02	8.67E-03
Zn-65	1.47	2.41E-02	1.51E-02
Cs-134	0.00063	2.00E-06	8.06E-07
Cs-137	38.18	1.02E-01	2.68E-02
Ce-141	8.8E-10	1.36E-13	1.32E-14
	Total Dose =	1.37E-01	5.07E-02
	Dose Limit per field =	1	1
	% of Dose limit	13.7%	5.1%

Table 22
Past Spreading Intruder Period Doses
At End of Plant License in 2013
(No Stored Material or Future Additions Included after 11/4/03)

Isotope	Total Activity Remaining on South Field as of 11/04/03 uCi/acre	Total Activity Remaining on South Field decayed corrected to 2013 uCi/acre	Max Organ Existing Material from Past Spreading Mrem/year	Whole Body Existing Material from Past Spreading Mrem/year
Mn-54	0.241	1.02E-04	1.04E-06	3.18E-07
Co-60	16.33	4.636	1.48E-01	4.21E-02
Zn-65	1.47	7.08E-05	1.34E-06	8.85E-07
Cs-134	0.00063	2.53E-05	3.07E-07	2.37E-07
Cs-137	38.18	30.66	2.14E-01	1.18E-01
Ce-141	8.8E-10	3.60E-42	4.36E-44	1.24E-45
		Total Dose =	3.62E-01	1.60E-01
		Dose Limit per field =	5	5
		% of Dose limit	7.2%	3.2%

Table 23
Control Period Dose: Past
Spreading & Current Stored Soil
Inventory (as of 6/1/04)

Isotope	Max Organ Existing Material from Past Spreading Mrem/year	Whole Body Existing Material from Past Spreading Mrem/year	Max Organ Stored Material to be Spread Mrem/year	Whole Body Stored Material to be Spread Mrem/year	Max Organ All Past Spreading Plus Stored Inventory Mrem/year	Whole Body All Past Spreading Plus Stored Inventory Mrem/year
Mn-54	5.67E-05	2.92E-05	7.99E-05	4.11E-05	1.37E-04	7.03E-05
Co-60	1.09E-02	8.04E-03	1.94E-04	1.43E-04	1.10E-02	8.18E-03
Zn-65	1.33E-02	8.33E-03	9.50E-03	5.96E-03	2.28E-02	1.43E-02
Cs-134	1.65E-06	6.65E-07	0.00E+00	0.00E+00	1.65E-06	6.65E-07
Cs-137	1.00E-01	2.65E-02	4.28E-02	1.13E-02	1.43E-01	3.78E-02
Ce-141	1.54E-15	1.50E-16	0.00E+00	0.00E+00	1.54E-15	1.50E-16
Total Dose =	1.24E-01	4.29E-02	5.26E-02	1.75E-02	1.77E-01	6.03E-02
Dose Limit per field =	1	1	1	1	1	1
% of Dose limit	12.4%	4.3%	5.3%	1.7%	17.7%	6.0%

Table 24
Past Spreading & Stored Soil Inventory (No Future Additions)
Intruder Dose at End of Plant License in 2013

Isotope	Max Organ Existing Material from Past Spreading Mrem/year	Whole Body Existing Material from Past Spreading Mrem/year	Max Organ Stored Material to be Spread Mrem/year	Whole Body Stored Material to be Spread Mrem/year	Max Organ All Past Spreading Plus Stored Inventory Mrem/year	Whole Body All Past Spreading Plus Stored Inventory Mrem/year
Mn-54	1.04E-06	3.18E-07	1.47E-06	4.48E-07	2.50E-06	7.66E-07
Co-60	1.48E-01	4.21E-02	2.64E-03	7.52E-04	1.51E-01	4.29E-02
Zn-65	1.34E-06	8.85E-07	9.58E-07	6.33E-07	2.30E-06	1.52E-06
Cs-134	3.07E-07	2.37E-07	0.00E+00	0.00E+00	3.07E-07	2.37E-07
Cs-137	2.14E-01	1.18E-01	9.14E-02	5.04E-02	3.05E-01	1.68E-01
Ce-141	4.36E-44	1.24E-45	0.00E+00	0.00E+00	4.36E-44	1.25E-45
Total Dose =	3.62E-01	1.60E-01	9.41E-02	5.12E-02	4.56E-01	2.11E-01
Dose Limit per field =	5	5	5	5	5	5
% of Dose limit	7.2%	3.2%	1.9%	1.0%	9.1%	4.2%

Table 25
Dose Impact from Spreading of Current Inventory of Stored Material Only*

Isotope	Total Stored Waste Activity As of 06/01/04** (uCi/acre)	Max Organ Control (06/01/04) mrem/year	Whole Body Control (06/01/04) mrem/year	Max Organ Intruder (2013) mrem/year	Whole Body Intruder (2013) mrem/yr	% Contribution Max organ by isotope Intruder Dose	% Contribution Max organ by isotope Control Period Dose
Mn-54	2.13E-01	7.99E-05	4.11E-05	1.47E-06	4.48E-07	0.00%	0.032%
Co-60	2.70E-01	1.94E-04	1.43E-04	2.64E-03	7.52E-04	0.25%	0.077%
Zn-65	5.79E-01	9.50E-03	5.96E-03	9.58E-07	6.33E-07	0.00%	3.760%
Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0000%	0.0000%
Cs-137	1.61E+01	4.28E-02	1.13E-02	9.14E-02	5.04E-02	8.7%	17.0%
Ce-141	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0000%	0.0000%
Ce-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0000%	0.0000%
	Total Dose =	5.26E-02	1.75E-02	9.41E-02	5.12E-02	8.9%	20.8%
	Dose Limit =	1	1	5	5		
	% of Dose Limit	5.3%	1.7%	1.9%	1.0%		

* Includes only Stored soil/sand materials collected as of end of 2003 (See Table 1)
** Total Activity values from Table 12.

Table 26

Past, Stored Materials and Projected Future Disposal (all septage/silt and soils) Doses at End of Plant License*

Isotope	Total Waste Activity in 2013** (uCi/acre)	Max. Organ Control mrem/year	Whole Body Control mrem/year	Max. Organ Intruder mrem/year	Whole Body Intruder mrem/yr	% Contribution Max organ by isotope Intruder Dose	% Contribution Max organ by isotope Control Period Dose
Mn-54	1.85E-01	6.94E-05	3.57E-05	1.89E-03	5.77E-04	0.18%	0.027%
Co-60	1.33E+01	9.54E-03	7.06E-03	4.24E-01	1.21E-01	40.30%	3.776%
Zn-65	4.58E-01	7.51E-03	4.72E-03	8.66E-03	5.73E-03	0.82%	2.974%
Cs-134	1.21E-02	3.85E-05	1.55E-05	1.46E-04	1.13E-04	0.0139%	0.0152%
Cs-137	8.85E+01	2.35E-01	6.21E-02	6.18E-01	3.41E-01	58.7%	93.2%
Ce-141	6.79E-03	1.05E-06	1.02E-07	8.22E-05	2.34E-06	0.0078%	0.0004%
Ce-144	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.0000%	0.0000%
	Total Dose =	2.53E-01	7.40E-02	1.05E+00	4.68E-01	100.0%	100.0%
	Dose Limit =	1	1	5	5		
	% of Dose Limit	25.3%	7.4%	21.1%	9.4%		

* Includes all past spreadings, soil stored Between Cooling Towers (as of 11/4/03), and all annual projected additions of septage/silt/soil.
** Total Activity values from last column of Table 19.

REFERENCES

(1) Vermont Yankee Off site Dose Calculation Manual (ODCM), Revision 30, including the following appendixes:

(i) Appendix B, "Approval of Criteria for Disposal of Slightly Contaminated Septic Waste On-Site at Vermont Yankee" (Included NRC approval letter dated August 30, 1989, VY request for approval dated June 28, 1989 with Attachments I and II.)

(ii) Appendix F, "Approval Pursuant to 10CFR20.2002 For Onsite Disposal of Cooling Tower Silt" (Included NRC approval letter dated March 4, 1996, VY Request for Approval dated August 30, 1995.)

(iii) Appendix H, "Request to Amend Previous Approvals Granted Under 10CFR20.302(a) for Disposal of Contaminated Septic Waste and Cooling Tower Silt to Allow for Disposal of Contaminated Soil" dated June 23, 1999, with supplements dated January 4, 2000, and June 15, 2000.

(2) USNRC Regulatory Guide 1.109, Rev.1; "Calculation of Annul Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 40, Appendix I," dated October 1997.

Appendix A

Security Fence Upgrade
Soil
Pile #2002-01

	Soil Analysis Data			Density from samples data	
Sample location #	Cs137 detected (uCi/gm)	Cs-137 LLD reported (uCi/gm)	Mn-54 detected (uCi/gm)	Volume (cc)	wet weight (gm)
3B	5.76E-08			1200	1266
3F	1.16E-07			1200	1062
4A	7.76E-08			1200	1393
4B	5.62E-08			1200	1512
4D	4.81E-08			1200	1483
4F	1.15E-07			1200	1137
5A	6.95E-08			1200	1390
5D	1.84E-07			1200	1194
5F	1.72E-07		5.86E-08	1200	1051
1A		3.93E-08		1200	985
1B		5.97E-08		1200	1335
1C		2.92E-08		1200	1188
1D		7.39E-08		1200	1355
1E		3.65E-08		1200	1686
1F	4.18E-08			1200	1294
2A		6.83E-08		1200	1240
2B		8.53E-08		1200	1043
2C		4.88E-08		1200	1171
2D		4.16E-08		1200	1420
2E		3.43E-08		1200	1304
2F		4.75E-08		1200	1360
3A		8.35E-08		1200	1189
3C	9.59E-08			1200	1348
3E	5.65E-08			1200	1073
4C		4.44E-08		1200	1486
4E		9.37E-08		1200	1057
5B		7.23E-08		1200	1428
5C	4.53E-08			1200	1551

			averages	1200	1285.75
Wt. Positive Ave. =	4.06E-08		Density	1.07	gm/cc
			Density	1071.46	kg/m3
Positive & LLD ave. =		7.12E-08			

Appendix B

Security Fence Upgrade Soil
Pile # 2002-02

Sample location #	Cs137 detected (uCi/gm)	Cs-137 LLD reported (uCi/gm)	Zn-65 detected (uCi/gm)	Volume (ml)	wet weight (gm)
	Soil Analysis data			Density from Sample Data	
A3	3.98E-08			1200	1388
A4		6.93E-08		1200	1221
A5		4.53E-08		1200	1278
A6		4.69E-08		1200	1249
A7		4.04E-08		1200	1335
A8		7.29E-08		1200	1274
B1		4.06E-08	7.73E-08	1200	1392
B2		3.02E-08		1200	1404
B3		4.08E-08		1200	1313
B4		3.34E-08		1200	1230
B5		3.38E-08		1200	1241
B6	2.13E-08			1200	1299
B7		4.24E-08		1200	1297
B8		3.73E-08		1200	1475
C3		3.90E-08		1200	1696
C4		4.25E-08		1200	1329
C5	4.06E-08			1200	1318
C6		4.14E-08		1200	1230
C7		4.60E-08		1200	1335
D7		3.22E-08		1200	1294
wtd positive ave.	5.09E-09		average	1200	1329.9
			density	1.11	gm/cc
Positive & LLD ave. =		4.18E-08		1108.25	kg/m3

Appendix C

Security Fence Upgrade
Soil
Pile # 2002-03

Soil Analysis Data				Density from samples data	
Sample location #	Cs137 detected (uCi/gm)	Cs-137 LLD reported (uCi/gm)		Volume (ml)	Wet weight (gm)
1		3.00E-08		1000	1348
2		3.46E-08		1100	1424
3		2.58E-08		1100	1410
4		3.72E-08		1100	1410
5	3.84E-08			1000	1034
6		4.58E-08		1200	1108
7		3.14E-08		1000	1526
8		4.29E-08		1000	1532
9		5.42E-08		1000	1086
10		5.00E-08		1000	1289
11		5.68E-08		1000	1185
12		4.62E-08		1000	1135
			average	1041.67	1290.58
wt positive aver.=	3.2E-09		density	1.24	gm/cc
				1238.96	kg/m3
Positive & LLD ave. =		4.11E-08			

Appendix D

2001 Protected Area Road Sweeping Pile

Soil Analysis Data						Density from Sample Data		
Sample location #	Cs137 detected (uCi/gm)	Cs-137 LLD reported (uCi/gm)	Co-60 detected (uCi/gm)	Co-60 LLD reported (uCi/gm)	Mn-54 detected (uCi/gm)	Volume (ml)		wet weight (gm)
1	6.55E-08			5.36E-08			1000	1435
2		3.43E-08		4.24E-08			1100	1753
3		2.91E-08		3.03E-08			1000	1550
4		4.83E-08		4.95E-08			1000	1615
5		6.37E-08		7.83E-08			1000	1657
6		3.67E-08		4.10E-08			1000	1609
7	1.96E-08		3.13E-08				1000	1565
8							1000	1650
9	3.11E-08			2.26E-08			1000	1439
10	6.09E-08		6.05E-08				1005	1762
11	4.07E-08		4.63E-08				1000	1421
12	4.75E-08			2.35E-08	1.23E-08		1000	1454
13	7.14E-08			4.30E-08			1000	1561
14	4.04E-08			3.22E-08			1000	1659
15		6.65E-08		6.47E-08	5.92E-08		1000	1503
16	4.20E-08			3.73E-08			1000	1607
17	4.69E-08			3.13E-08			1000	1536
18	5.05E-08			6.21E-08			1000	1594
19	5.45E-08			5.59E-08			1000	1474
20	6.25E-08		3.62E-08		2.38E-08		1000	1427
wt positive ave.=	3.17E-08		8.72E-09		4.77E-09	average	1005.2	1563.5
						density	1.56	gm/cc
Positive & LLD ave.=		4.80E-08		4.43E-08			1555.4	kg/m3

Appendix E

2001 HWC Soil Excavations

	Soil Analysis Data				Density from Sample data	
Sample location #	Cs137 detected (uCi/gm)	Cs-137 LLD reported (uCi/gm)	Zn-65 detected (uCi/gm)		Volume (ml)	wet weight (gm)
1	4.09E-08				1000	1099
2		6.11E-08			1000	1043
3	6.04E-08				1000	1007
4	4.78E-08				1000	1008
5		5.30E-08			1000	1103
6		5.77E-08			1000	1025
7		5.94E-08			1000	956
8	4.75E-08				1000	957
9	5.05E-08				1000	976
10		6.16E-08			1000	1050
11		5.54E-08			1000	1043
12		6.50E-08			1000	1126
13	3.44E-08				1000	1141
14	5.67E-08				1000	997
15		5.26E-08			1000	1105
16		5.80E-08			1000	1190
17		5.58E-08	na		1000	1040
18		5.29E-08			1000	1141
19		5.85E-08			1000	1050
20	5.20E-08				1000	1073
wt positive ave.=	1.95E-08			average=	1000	1056.5
Positive & LLD ave.=		5.41E-08		density =	1.0565 1056.5	gm/cc kg/m3

Appendix F

1996 Soil Remnants Analysis –Security Fence Upgrade

The attached report ("Radioactivity Analyses for Soil Piles Stored Between Cooling Towers", REG-115/96, dated July 15, 1996) indicates that two soil piles totaling 4000 ft^3 were collected in 1995 and stored between the Cooling Towers. Even though the larger of the two piles (3100 ft^3) did not indicate any detectable plant related radioactivity, the two piles were eventually combined with portions disposed of by land spreading on the South disposal plot as annual disposal volume limits for soil/sand mixes permitted. The remnants of the piles currently contain about 970 ft^3 of material. For the estimated concentration of Cs-137 in the combined piles, concentration values from Tables 1 and 3 were averaged in proportion to there volumes as shown:

Cs-137: 900 ft^3 at an average concentration of 328 pCi/kg
3100 ft^3 with no detectable activity (average absolute value = 11 pCi/kg)

$$\text{Average concentration (weighted ave.)} = \frac{900\ ft^3 * 328 pCi/kg + 3100\ ft^3 * 11\ pCi/kg}{900\ ft^3 + 3100\ ft^3}$$

$$= 82.33\ pCi/kg\ (dry)$$

Therefore, on a wet weight basis applicable to the measured volume of the remaining pile of soil between the Cooling Towers, the weighted average concentration for Cs-137 is:

$$= 82.33\ pCi/kg * 1kg/1000\ g * 1E\text{-}06\ uCi/pCi * 1.12\ wet/dry\ volume\ ratio$$

$$= 9.22\ E\text{-}08\ uCi/gm\ (wet)\ for\ Cs\text{-}137$$

For Co-60;

$$\text{Average concentration (weighted ave.)} = \frac{900\ ft^3 * 85\ pCi/kg + 3100\ ft^3 * 0.034\ pCi/kg}{900\ ft^3 + 3100\ ft^3}$$

$$= 19.15\ pCi/kg$$

On a wet weight basis applicable to the measured volume of the remaining pile of soil between the Cooling Towers, the weighted average concentration for Co-60 is:

$$= 19.5\ pCi/kg * 1kg/1000\ g * 1E\text{-}06\ uCi/pCi * 1.12\ wet/dry\ volume\ ratio$$

$$= 2.14\ E\text{-}08\ uCi/gm\ (wet)\ for\ Co\text{-}60.$$

MEMORANDUM

YANKEE ATOMIC - BOLTON

To	G. D. Weyman	Date	July 15, 1996
		Group #	REG-115/96
From	M. S. Strum	W.O.#	
Subject	Radioactivity Analyses for Soil Piles Stored Between the Cooling Towers	I.M.S.#	
		File #	vysoilac.doc

REFERENCES

(1) Environmental Laboratory Analysis Reports Sample Numbers G22686 through G22735, soil - Fence and Repaving. Reference Date 4/13/95.

BACKGROUND

Site area construction activities have generated two piles of soil from the protected area that were placed between the plant's cooling towers pending radiological assessment and final disposal disposition. One pile was estimated at 3100 cubic feet and was initially marked as having come from security fence excavation. The second pile, estimated at about 900 cubic feet, was placed directly south of the first pile and east of the 14,000 cubic feet of cooling tower silt also stored between the towers. This second pile was initially designated as coming from repaving activities. (Note that these designations may have been reversed with the repaving activity generating the 3100 cubic feet of material and the security fence excavation generating the 900 cubic feet of material.)

DISCUSSION

As we discussed last week, I'm forwarding copies of the laboratory analyses (Reference 1) for two piles of dirt currently located immediately east of the cooling tower silt pile between the plant's cooling towers.

The 3100 cubic foot pile was sampled by collecting 30 composite grab samples (G22686 through G22715) taken at equal distances long its 82 foot length (the pile is about 15.5 feet wide and 4 feet high at its peak). Each composite sample is consist of 3 grab aliquots taken on the left, top, and right side of the pile at each reference distance starting from the pile's north end. The comment field on each analysis report indicates a sample location relative to the north end of the pile. As an example, sample G22691 has a comment of 6-15.0, indicating the 6th sample taken at a distance of 15.0 feet from the north end of the pile.

Tables 1 and 2 summarize the results of the gamma isotopic analyses for Cs-137 and Co-60. None of the 30 composite samples indicated any positive Cesium or Cobalt, or any other plant related radionuclide. As a consequence, this pile appears to be free from any radioactivity contamination.

The 900 cubic foot pile was sampled in the same manner as above, with a total of 20 composite samples collected (G22716 through G22735). Table 3 shows that both Cs-137 and Co-60 were detected in all or most of the grab samples, indicating that positive plant related radioactivity exists in the soil, and that 10CFR20.2002 approval for disposal will be needed.

Please call at your convenience to discuss the next steps necessary to handle the 900 cubic foot pile.

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Attachments

c

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Table 1
Vermont Yankee Soil Analysis

E-Lab soil data for 3100 ft3 soil marked as
"Fence" line construction material
Cs-137
(pCi/kg dry)

Sample I.D.	Conc.	+- sigma	3 sigma	MDC
1-1.4	9	21	63	78
2-4.1	33	22	66	74
3-6.8	33	26	78	89
4-9.6	-9	23	69	91
5-12.3	20	21	63	73
6-15.0	15	19	57	69
7.17.8	-41	25	75	110
8.20.5	-6	21	63	86
9-23.2	-6	33	99	120
10-26.0	17	23	69	80
11-28.7	11	16	48	60
12-31.4	-14	21	63	82
13-34.2	-12	21	63	83
14-36.9	22	18	54	59
15-39.6	-12	22	66	87
16-42.4	15	18	54	64
17-45.1	12	28	84	99
18-47.8	17	21	63	77
19-50.6	-33	20	60	84
20-53.3	-42	23	69	94
21-56.0	26	36	108	130
22-58.8	26	27	81	93
23-61.5	30	25	75	86
24-64.2	18	25	75	89
25-67.0	28	26	78	89
26-69.7	46	23	69	73
27-72.4	33	23	69	76
28-75.2	48	23	69	70
29-77.9	37	25	75	84
30-80.6	9	29	87	100
Average:	11	23	70	85
Max. value:	48	36	108	130
Min. value:	-42	16	48	59

Table 2
Vermont Yankee Soil Analysis

E-Lab soil data for 3100 ft3 soil marked as
"Fence" line construction material
Co-60
(pCi/kg dry)

Sample I.D.	Conc.	+ - sigma	3 sigma	MDC
1-1.4	10	18	54	70
2-4.1	-12	23	69	100
3-6.8	-11	21	63	97
4-9.6	39	30	90	100
5-12.3	1	21	63	86
6-15.0	32	18	54	57
7.17.8	-50	25	75	120
8.20.5	16	15	45	56
9-23.2	43	28	84	91
10-26.0	-17	23	69	97
11-28.7	-13	21	63	93
12-31.4	-4	20	60	84
13-34.2	-2	17	51	75
14-36.9	4	25	75	98
15-39.6	-15	24	72	100
16-42.4	-39	28	84	120
17-45.1	-17	23	69	100
18-47.8	-14	29	87	130
19-50.6	-9	18	54	82
20-53.3	37	22	66	72
21-56.0	17	27	81	140
22-58.8	5	30	90	120
23-61.5	7	28	84	110
24-64.2	-10	19	57	90
25-67.0	27	27	81	98
26-69.7	1	29	87	120
27-72.4	16	21	63	79
28-75.2	6	25	75	98
29-77.9	-8	32	96	130
30-80.6	-27	23	69	110
Average:	0	24	71	97
Max. value:	43	32	96	140
Min. value:	-50	15	45	56

Table 3
Vermont Yankee Soil Analysis

E-Lab Analysis of soil from 900 ft3 pile initial marked "repaving dirt"

sample I.D.	Cs-137 (pCi/kg dry) Conc.	+- sigma	3 sigma	Positive Act. >3 sigma	Co-60 (pCi/kg dry) Conc.	+- sigma	3 sigma	Positive Act > 3 sigma
1-1.1	234	53	159	positive	49	38	114	ND
2-3.3	522	57	171	positive	143	29	87	positive
3-5.5	337	43	129	positive	37	21	63	ND
4-7.7	291	29	87	positive	111	17	51	positive
5-9.9	348	51	153	positive	47	29	87	ND
6-12.1	135	26	78	positive	73	23	69	positive
7-14.3	107	24	72	positive	82	15	45	positive
8-16.5	222	44	132	positive	140	28	84	positive
9-18.7	180	37	111	positive	92	21	63	positive
10-20.9	269	51	153	positive	118	31	93	positive
11-2.0	810	51	153	positive	114	21	63	positive
12-4.2	378	38	114	positive	106	21	63	positive
13-6.4	810	66	198	positive	124	27	81	positive
14-8.6	376	24	72	positive	62	13	39	positive
15-10.8	331	22	66	positive	87	12	36	positive
16-13	253	33	99	positive	5	22	66	ND
17-15.2	150	12	36	positive	57	9	27	positive
18-17.4	247	30	90	positive	105	17	51	positive
19-19.6	326	55	165	positive	54	40	120	ND
20-21.8	235	32	96	positive	100	23	69	positive
Average:	328	39			85	23		
Max. value:	810	66			143	40		
Min. value:	107	12			5	9		

Appendix G

Record for Last Spreadings (2003) on South Disposal Field

Total Recorded Spreading Data for 2003

Serial #	Spreading Date	Media Type	Mn-54 (uCi/acre)	Co-60 (uCi/acre)	Zn-65 (uCi/acre)	Cs-134 (uCi/acre)	Cs-137 (uCi/acre)	Ce-141 (uCi/acre)	Ce-144 (uCi/acre)
2003-01	7-1-3	Septic	--	1.03	--	--	--	--	--
2003-02	10-25-03	Septic	--	0.12	--	--	--	--	--
2003-03	11-4-03	Sand/soil	--	--	--	--	1.34	--	--
2003-04	11-4-03	CT Silt	--	0.256	--	--	--	--	--
		Total	--	1.41	--	--	1.34	--	--