VERMONT YANKEE
NUCLEAR POWER CORPORATION

185 Old Ferry Road, Brattleboro, VT 05301-7002
(802) 257-5271

January 4, 2000
BVY 00-02

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

References: (a) Letter, VYNPC to USNRC, "Request to Amend Previous Approvals Granted Under 10 CFR 20.302(a) for Disposal of Contaminated Septic Waste and Cooling Tower Silt to Allow for Disposal of Contaminated Soil," BVY 99-80, dated June 23,1999

Subject: **Vermont Yankee Nuclear Power Station**
License No. DPR-28 (Docket No. 50-271)
Supplement to Request to Amend Previous Approvals Granted
Under 10 CFR 20.302(a) to Allow for Disposal of Contaminated Soil

Reference (a) provided Vermont Yankee's application to amend the previously granted approvals to dispose of slightly contaminated septic waste and cooling tower silt on-site to include slightly contaminated soil generated as a residual by-product of on-site construction activities. The request was to allow the disposal of approximately 25.5 cubic meters of waste that has been accumulated to date and to allow for disposal of future waste from construction related activities.

Based on discussions with USNRC staff, additional information related to the estimated volume and dose consequences of the proposed future material was needed to complete your review. Attachment 1 has been revised accordingly to include the information requested. Attachment 1 supercedes the evaluation previously submitted.

We trust that the information will allow you to complete your review of our submittal. However; should you have any questions or require further information concerning this matter, please contact Mr. Jim DeVincentis at 802-258-4236.

Sincerely,

Vermont Yankee Nuclear Power Corporation

Gautam Sen
Licensing Manager

Attachment
cc: USNRC Region I Administrator
USNRC Resident Inspector - VYNPS
USNRC Project Manager - VYNPS
VT Department of Public Service

A001

PDR ADOCK 05000271

SUMMARY OF VERMONT YANKEE COMMITMENTS

BVY NO.: 00-02

The following table identifies commitments made in this document by Vermont Yankee. Any other actions discussed in the submittal represent intended or planned actions by Vermont Yankee. They are described to the NRC for the NRC's information and are not regulatory commitments. Please notify the Licensing Manager of any questions regarding this document or any associated commitments.

COMMITMENT	COMMITTED DATE OR "OUTAGE"
None	N/A

Docket No. 50-271
BVY 00-02

Attachment 1

Vermont Yankee Nuclear Power Station

Assessment of On-site Disposal of Contaminated Soil by Land Spreading

TABLE OF CONTENTS

Page

LIST OF TABLES 2

1.0 INTRODUCTION 3

1.1 Background 3

1.2 Objective 3

2.0 WASTE DESCRIPTION 4

3.0 SOIL DISPOSAL AND ADMINISTRATIVE PROCEDURE REQUIREMENTS 5

4.0 EVALUATION OF ENVIRONMENTAL IMPACTS 6

4.1 Site Characteristics 6

4.2 Radiological Impact 7

5.0 RADIOLOGICAL PROTECTION 9

6.0 CONCLUSIONS 9

7.0 REFERENCES 11

LIST OF TABLES

Table 1: Radioanalytical Results of Composite Soil Samples..... 12

Table 2: Estimated Total Radioactivity in 25.5 m^3 Soil Volume..... 12

Table 3: Estimated Total Radioactivity in Future Soil Additions..... 13

Table 4: Record of Septic and Silt Radioactive Material Spread each Year on South Field Disposal Plot..... 13

Table 5: Total Projected Radioactivity Remaining on South Filed at License Expiration..... 14

Table 6: All-Pathway Critical Organ/Whole Body Dose Conversion Factors..... 14

Table 7: Dose Impact from Past Septic and Silt Spreading Activity..... 15

Table 8: Dose Impact from Past Septic and Silt Spreading and Single 25.5m^3 Soil Disposal..... 15

Table 9: Dose Impact from Present and Future Soil Disposal Along with Past Septic and Silt Disposal..... 16

Table 10: Dose Impact from Past Disposals through 7/15/99 Plus all Annual Projected Disposals of Septic, Silt and Soil..... 16

Table 11: Summary of Dose Impacts Associated with Different Disposal Scenarios..... 17

1.0 INTRODUCTION

1.1 Background

In 1989, Vermont Yankee Nuclear Power Corporation requested approval from the NRC 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 and the information was permanently incorporated into the Offsite Dose Calculation Manual (ODCM) as Appendix B.

In 1995, Vermont Yankee Nuclear Power Corporation requested that the previous authorization for on-site disposal of very low-level radioactive material in septic waste be amended to permit the on-site disposal of slightly contaminated cooling tower silt material. Approval from the NRC was granted on June 18, 1997 and the information was permanently incorporated into the ODCM as Appendix F.

In 1994, approximately 25.5 m^3 of excess soil was generated during on-site construction activities. Subsequent sampling and analysis of the soil revealed low levels of radioactivity that were similar in radionuclides and activity to the septic waste and cooling tower silts previously encountered. An evaluation determined that the soil could be managed in similar fashion as the septic waste and cooling tower silts; however, prior approval from the NRC would be required under 10 CFR 20.2002 (formerly 20.302(a)).

1.2 Objective

The purpose of this assessment is to present the data and radiological evaluation to demonstrate that the proposed disposition of the soil (i.e., on-site disposal via land spreading on designated fields) will meet the existing boundary dose conditions as approved by the NRC for septic waste and cooling tower silt. The boundary conditions established for disposal of the septic waste and cooling tower silt on designated plots are:

1. The dose to the whole body or any organ of a hypothetical maximally exposed individual must be less than 1.0 mrem/yr.

2. Doses to the whole body and any organ of an inadvertent intruder from the probable pathways of exposure are less than 5 mrem/yr.

3. Disposal operations must be at one of the approved on-site locations.

2.0 WASTE DESCRIPTION

The existing accumulation of contaminated soil was derived from excavation activities associated with the construction of a new security fence along the plant's Protected Area boundary. The volume of soil generated was approximately 25.5 m^3, and is typical of fill material containing light to dark brown poorly sorted soils with some small stones, and includes 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 a location 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 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 had accumulated over time to low level detectable concentrations.

In April 1995, a total of 20 composite soil samples were collected to characterize the accumulated volume. Composites were obtained by taking a grab sample from opposite sides of the pile and the top at equal distances along its length. These three grab samples were then combined into one composite sample. Soil samples were sent to the Yankee Atomic Environmental Laboratory for analysis and counted to environmental lower limits of detection required of environmental media. Results of the analyses are presented in Table 1. For estimating the total activity in the soil pile, the actual analytical result was used for those samples that were less than the MDC to calculate the average radioactivity concentration. Analytical results are provided for both the times when the samples were collected as well as decay corrected to the present (7/15/99). The results identified both Cs-137 and Co-60 in most of the composite samples, which verified that plant-related radioactivity, was present in the soil.

The mass of accumulated soil (dry) was estimated by multiplying the total in-situ volume (25.5 m^3) by it's wet density, 1.47E+03 kg/m^3, and then dividing by the wet:dry ratio of 1.12, thus yielding a mass of 3.35E+04 kg (dry). The mass of the soil was then multiplied by the average measured Co-60 and Cs-137 concentrations to obtain the total activity of each radionuclide in the 25.5 m^3. Table 2 presents the estimated total radioactivity in the 25.5 m^3 volume at the time of sample collection and analysis, and decay corrected to the date of the most recent disposal (septic waste) spreading operation (i.e., July 15, 1999).

In addition to the existing 25.5 m^3 (900 ft^3) of soil included in this request, it is anticipated that the need to dispose of very low-level contaminated soil will occur in the future. Each spring, approximately 28.3 m^3 (1000 ft^3) of road and walkway sand spread during the winter season is swept up from inside the Protected Area. This material is subject to the same contamination mechanisms that are believed to have lead to the observed contamination in the construction fill removed from within the Protected Area in the past. For purposes of

evaluating the radiological impact of potential future soil disposals, it is assumed that an additional 28.3 m^3 per year of sand / soil is contaminated at the same concentration levels as originally observed (April 1995) in the currently collected 25.5m^3 of soil. It is also assumed that this material is placed on the same approved disposal field used for all past septic and cooling tower silt disposal operations. Table 3 shows the estimated amount of radioactivity associated with the annual disposal of the 28.3m^3 of soil. It is assumed that this material is disposed of each year for the next 14 years (until the end of plant operating license in 2013) on the same field (South Disposal Plot) along with the continued application of septic waste and cooling tower silt.

Table 4 shows a record of the actual amount of septic/silt material that has been spread on south field for the past 10 years. A review of the actual waste disposal operations show that the annual average radioactivity content placed on the 1.9 acre South field from septic and silt disposals are as follows:

Mn-54	0.147	uCi/year
Co-60	2.58	uCi/year
Zn-65	0.269	uCi/year
Cs-134	0.010	uCi/year
Cs-137	6.21	uCi/year

The maximum radioactivity inventory resulting from the accumulated buildup of past and projected future disposal operations (i.e., septic waste, cooling tower silt, plus the existing 25.5m^3 of accumulated soil along with a projected annual addition of 28.3m^3 of soil each year until the termination of the operating license) is shown on Table 5.

3.0 SOIL DISPOSAL AND ADMINISTRATIVE PROCEDURE REQUIREMENTS

The method of soil disposal 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. The accumulation of radioactivity on the disposal plot for this 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 designated and approved for septic waste and cooling tower silt disposal and has been used for all past disposal operations, and is expected to be used for the placement of soil. Determination of the radiological dose impact has been made based on the same models and pathway assumptions used in the previous submittals.

Dry soil material will be dispersed using typical agricultural dry bulk surface spreading practices in approved disposal areas on-site. Incidental pieces of asphalt and stones that are picked up with the soil will be screened out before the soil is spread and disposed of as radioactive material at an off-site licensed facility if detectable radioactivity is found.

Records of the disposal that will be maintained include the following:

(a) The radionuclide concentrations detected in the soil (measured to environmental lower limits of detection).
(b) The total volume of soil 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.
(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 soil containing low levels of radioactivity will not exceed the boundary dose limits, each new spreading operation will require an estimate of total radioactivity that includes all past disposals of septic waste, cooling tower silt and soil material on the designated disposal plots. This will be compared with the boundary dose limits or equivalent radioactivity limits on a per acre basis. 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 (or other approved waste) 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 the previously approved septic waste spreading application.

4.0 EVALUATION OF ENVIRONMENTAL IMPACTS

4.1 Site Characteristics

All designated disposal sites are located on the Vermont Yankee Nuclear Power 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 parcel of land has been previously approved by the NRC for the land disposal of septic waste and cooling tower silt, and is the only portion of the approved disposal areas which has been utilized to-date for the spreading of contaminated material. For estimating the maximum future radiological impact, it is assumed in the analysis that all future disposal operations will continue to use the South field as the disposal plot.

4.2 Radiological Impact

The amount of radioactivity added to the south field is procedurally controlled to ensure that doses are maintained within the prior approved limits of the boundary conditions.

To assess the dose received by the maximally exposed individual during the period of plant controls over the property, and to an inadvertent intruder after it is assumed plant access controls end, the same pathway modeling, assumptions and dose calculation methods as approved for septic and cooling tower silt disposal were used. These dose models implement the methods and dose conversion factors as provided in Regulatory Guide 1.109, Revision 1 (1977).

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.
(f) Ingestion of cow's milk.

As shown in the previous application for septic waste disposal, the liquid pathway was found to be an insignificant contributor to the dose for the radionuclides identified fixed in the soil type matrixes associated these waste forms. Therefore, the liquid pathway is not considered in this analysis.

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

(a) Exposure to ground contamination and re-suspended radioactivity 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).

(b) For the purpose of projecting and illustrating the magnitude of dose impact over the remaining life of the plant, it is assumed that future disposals of septic and silt material will be placed annually on the same field at the annual average radioactivity levels observed for these waste streams over the past ten years. The future disposals will also consist of the additional 28.3 m^3 (1000 ft^3) annual volume of new soil at the same radioactivity concentrations observed at the time of collection of the existing 25.5 m^3 soil volume. 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 re-suspended 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 impact 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). For each year's spreading operations, the soil exposure time to account for buildup was changed from the standard 15 years to 1 year.

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

(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 re-suspension 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.

The dose models and methods used to generate deposition values and accumulated activity over the operating life of the plant are documented in the Vermont Yankee ODCM. The total activity that would be present on south field at the end of the operating period (i.e., total elapsed time of 14 years post July 15, 1999, or 2013) from the buildup of all waste streams (i.e., septic, cooling tower silt and soil) is presented in Table 5.

In order to evaluate the dose impact associated with the different disposal streams, a dose assessment was performed for the following four disposal scenarios:

(I) Impact from past septic and silt spreading only – Table 7
(II) Impact from past septic and silt spreading, plus a single 25.5m^3 soil disposal operation for the existing accumulated soil – Table 8
(III) Impact from past septic and silt disposals along with the existing 25.5 m^3 of accumulated soil and postulated future annual soil disposal volumes (28.3 m^3 /yr). –Table 9
(IV) Impact from past septic and silt disposals plus annual projected disposals of septic, silt and soil. – Table 10

For each scenario, the critical organ and whole body dose from all pathways to a maximally exposed individual for both the Vermont Yankee control period and the inadvertent intruder situation were calculated. The dose calculations were performed using the dose conversion factors presented in Table 5, which were obtained from the Vermont Yankee ODCM, Appendix F, "Approval Pursuant to 10CFR20.2002 for On-Site Disposal of Cooling Tower Silt."

A summary of the calculated dose impact associated with the four different scenarios is shown in Table 11. These results demonstrate that disposal of the 25.5 m^3 of accumulated soil will be well within the accepted dose limit criteria of 1 mrem/yr to any organ or whole body during the control period, and 5 mrem/yr to an inadvertent intruder. In addition, if continued soil spreading is necessary, the resulting dose is expected to also remain below the established limits even assuming the annual application of already approved disposal media (i.e., septic waste and cooling tower silt).

5.0 RADIOLOGICAL PROTECTION

The disposal operation of the soil 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 waste and cooling tower silt disposal.

6.0 CONCLUSIONS

Soil generated from on-site construction and maintenance activities constitutes an earthen type material similar in characteristics to septic waste residual solids and cooling tower silt with respect to the radiological pathway behavior and modeling. Based on the similarity in characteristics between the proposed soil volume and waste streams that have already been approved for disposal and the evaluation of the incremental dose impact, it is concluded that the disposal of the existing 25.5 m^3 and the projected 28.3 m^3/year of soil through on-site land spreading will meet the existing NRC approved boundary dose conditions specified in

the Vermont Yankee ODCM (see Appendix B for Septic Waste Disposal). That is, with respect to the addition of the initial 25.5 m^3 of soil along with the projected 28.3 m^3/year of soil and the projected future disposal of septic and silt waste to the existing radioactivity already spread on the south field:

1. Total doses to the whole body and critical organ of the hypothetically maximally exposed individual were estimated as 1.15E-01 mrem/yr and 4.03E-01 mrem/yr, respectively, which are less than the prescribed 1.0 mrem/yr limit during the period of active site control.

2. Total doses to the whole body and critical organ of an inadvertent intruder from the probable pathways of exposure were estimated as 7.57E-01 mrem/yr and 1.17 mrem/yr, respectively, which are less than 5 mrem/yr limit associated with an intruder scenario following assumed loss of site access control as the end of the operating license.

3. For purposes of projecting maximum impact, all disposals (past and future) are assumed to take place on the south disposal plot.

Therefore, the disposition of the present 25.5 m^3 and the projected 28.3 m^3/year of soil will continue to meet the existing boundary conditions as approved by the NRC for septic waste and cooling tower silt.

7.0 REFERENCES

(1) Vermont Yankee ODCM, Rev 23, Appendix B, "Approval of Criteria for Disposal of Slightly Contaminated Septic Waste On-Site at Vermont Yankee".

(2) Vermont Yankee ODCM, Rev 23, Appendix F, "Approval Pursuant to 10CFR20.2002 for On-Site Disposal of Cooling Tower Silt".

(3) USNRC Regulatory Guide 1.109, Rev 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10CFR Part 40, Appendix I", dated October 1977.

Table 1

Radioanalytical Results of Composite Samples Taken from 25.5m^3 Soil Pile

Sample ID	Cs-137 (pCi/kg) April, 1995	Cs-137 (pCi/kg) July 15, 1999	Co-60 (pCi/kg) April, 1995	Co-60 (pCi/kg) July 15, 1999	
G22716	234	212.2	49	28.0	*
G22717	522	473.4	143	81.7	
G22718	337	305.7	37	21.1	*
G22719	291	263.9	111	63.4	
G22720	348	315.6	47	26.8	*
G22721	135	122.4	73	41.7	
G22722	107	97.0	82	46.8	
G22723	222	201.4	140	80.0	
G22724	180	163.3	92	52.6	
G22725	269	244.0	118	67.4	
G22726	810	734.7	114	65.1	
G22727	378	342.8	106	60.6	
G22728	810	734.7	124	70.8	
G22729	376	341.0	62	35.4	
G22730	331	300.2	87	49.7	
G22731	253	229.5	5	2.9	*
G22732	150	136.0	58	33.1	
G22733	247	224.0	105	60.0	
G22734	326	295.7	54	30.8	*
G22735	235	213.1	100	57.1	
Average	328	298	85	49	
Maximum	810	735	143	82	
Minimum	107	97	5	3	
Std Dev.	186	169	36	20	

*The apparent response of the gamma isotopic analysis was less than the Minimum Detectable Concentration.

Table 2

Estimated Total Radioactivity in 25.5m^3 Accumulated Soil

Nuclide	Volume of Soil (m3)	Soil Mass (kg - dry)	Average Concentration (pCi/kg – dry) April 1995	Average Concentration (pCi/kg – dry) July 15, 1999	Total Activity (uCi) April 1995	Total Activity (uCi) July 15, 1999
Cs-137	25.5	3.35E+04	328	298	11.0	10.0
Co-60	25.5	3.35E+04	85	49	2.8	1.6

Table 3
Estimated Total Radioactivity in Future Soil Additions

Nuclide	Volume of soil (m^3)	Soil Mass (kg-dry)	Average Concentration (pCi/kg-dry assuming) (April, 1995 concentrations)	Total Activity (uCi/yr)
Cs-137	28.3	3.72E+04	328	12.8
Co-60	28.3	3.72E+04	85	3.16

Table 4
Record of Septic and Silt Radioactive Material Spread Each Year on the South Field

Year	Spreading Date	Material Type	Mn-54 (uCi/acre)	Co-60 (uCi/acre)	Zn-65 (uCi/acre)	Cs-134 (uCi/acre)	Cs137 (uCi/acre)	Ce-141 (uCi/acre)
1990	10/31/90	Septage	0.00	3.89	0.00	0.00	0.26	0.00
1990	11/20/90	Septage	0.17	2.03	0.41	0.00	0.29	1.40E-08
1991		no spreading	0.00	0.00	0.00	0.00	0.00	0.00
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	0.00	0.30	0.00
1994	06/14/94	septage	0.08	0.43	0.00	0.00	0.09	0.00
1995	06/29/95	septage	0.00	0.88	0.00	0.00	0.00	0.00
1996		no spreading	0.00	0.00	0.00	0.00	0.00	0.00
1997	06/18/97	septage	0.12	1.00	0.00	0.00	0.19	0.00
1998	07/30/98	septage	0.14	0.72	0.09	0.00	0.12	0.00
1998	09/28/98	Silt	0.00	0.00	0.00	0.00	30.87	0.00
1999	07/15/99	Septage	0.11	1.47	0.20	0.00	0.25	0.00
Average Activity/yr (uCi/acre):			0.08	1.36	0.14	0.01	3.27	0.01
Average Activity (uCi/yr) to be disposed of on 1.9 acre field			0.147	2.58	0.269	0.010	6.21	0.001 not significant

Table 5

Total Projected Radioactivity Remaining on South Field after License Termination

Nuclide	Accum. Activity in Silt & Septic @ Year 2013 (uCi)	Accum. Activity in Soil @ year 2013 (uCi)	Accum. Activity Total All Paths @ year 2013 (uCi)	Accum. Activity Total All Paths @ Year 2013 (uCi/acre)*
Mn-54	0.26	-	0.26	0.14
Co-60	19.68	21.83	41.51	21.85
Zn-65	0.42	-	0.42	0.22
Cs-137	119.03	154.74	273.78	144.09
Cs-134	0.04	-	0.04	0.02

* The total activity is assumed to be spread on the 1.9 acre South field to generate the uCi/acre value.

Table 6

All Pathway Critical Organ/Whole Body Dose Conversion Factors

		During VY Control		Post VY Control (Intruder Scenario)	
Radionuclide	Individual/Organ	Critical Organ Dose Factor (mrem/yr per µCi/acre)	Whole Body Dose Factor (mrem/yr per µCi/acre)	Critical Organ Dose Factor (mrem/yr per µCi/acre)	Whole Body Dose Factor (mrem/yr per µCi/acre)
Mn-54	Adult/GI-LLI	3.75E-04	1.93E-04	1.02E-02	3.12E-03
Co-60	Teen/Lung	7.17E-04	5.31E-04	3.19E-02	9.09E-03
Zn-65	Child/Liver	1.62E-02	1.03E-02	1.89E-02	1.25E-02
Cs-137	Child/Bone	2.66E-03	7.02E-04	6.98E-03	3.85E-03

Table 7 (Scenario I)

Dose Impact from Past Septic and Silt Spreading on South Field (as of 7/15/99)

Control Scenario:

	Half-Life (Years)	All Other Spreadings To Date (uCi/acre)	Maximum Organ Dose Factor (mrem/yr/uCi/acre)	Whole Body Dose Factor (mrem/yr/uCi/acre)	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Mn-54	0.86	0.20	3.75E-04	1.93E-04	7.35E-05	3.78E-05
Co-60	5.27	6.86	7.17E-04	5.31E-04	4.92E-03	3.64E-03
Zn-65	0.67	0.23	1.62E-02	1.03E-02	3.77E-03	2.40E-03
Cs-137	30.17	31.92	2.66E-03	7.02E-04	8.49E-02	2.24E-02
				Total Dose:	9.37E-02	2.85E-02
				Dose Limit:	1	1
				% of Limit:	9.37%	2.85%

Intruder Scenario:

	Half-Life (Years)	All Other Spreadings To Date (uCi/acre)	Activity on Plot Decayed to Year 2013 (uCi/acre)	Maximum Organ Dose Factor (mrem/yr/uCi/acre)	Whole Body Dose Factor (mrem/yr/uCi/acre)	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Mn-54	0.86	0.20	2.31E-06	1.02E-02	3.12E-03	2.36E-08	7.22E-09
Co-60	5.27	6.86	1.08E+00	3.19E-02	9.09E-03	3.46E-02	9.85E-03
Zn-65	0.67	0.23	1.15E-07	1.89E-02	1.25E-02	2.17E-09	1.43E-09
Cs-137	30.17	31.92	2.31E+01	6.98E-03	3.85E-03	1.62E-01	8.91E-02
					Total Dose:	1.96E-01	9.90E-02
					Dose Limit:	5	5
					% of Limit:	3.92%	1.98%

Table 8 (Scenario II)

Dose Impact from Past Septic/Silt Spreading and Single 25.5m^3 Soil Disposal

Control Scenario:

	Half-Life (Years)	All Spreadings to Date (uCi/acre)	Maximum Organ Dose Factor (mrem/yr/uCi/acre)	Whole Body Dose Factor (mrem/yr/uCi/acre)	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Mn-54	0.86	0.196	3.75E-04	1.93E-04	7.35E-05	3.78E-05
Co-60	5.27	7.70	7.17E-04	5.31E-04	5.52E-03	4.09E-03
Zn-65	0.67	0.233	1.62E-02	1.03E-02	3.77E-03	2.40E-03
Cs-137	30.17	37.19	2.66E-03	7.02E-04	9.89E-02	2.61E-02
				Total Dose:	1.08E-01	3.26E-02
				Dose Limit:	1	1
				% of Limit:	10.83%	3.26%

Intruder Scenario:

	Half-Life (Years)	All Spreadings to Date (uCi/acre)	Activity on Plot Decayed to 2013 (uCi/acre)	Maximum Organ Dose Factor (mrem/yr/uCi/acre)	Whole Body Dose Factor (mrem/yr/uCi/acre)	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Mn-54	0.86	0.196	2.31E-06	1.02E-02	3.12E-03	2.36E-08	7.22E-09
Co-60	5.27	7.70	1.22E+00	3.19E-02	9.09E-03	3.88E-02	1.11E-02
Zn-65	0.67	0.233	1.15E-07	1.89E-02	1.25E-02	2.17E-09	1.43E-09
Cs-137	30.17	37.19	2.70E+01	6.98E-03	3.85E-03	1.88E-01	1.04E-01
					Total Dose	2.27E-01	1.15E-01
					Dose Limit:	5	5
					% of Limit:	4.54%	2.30%

Table 9 (Scenario III)

Dose Impact from Present and Future Soil Disposal along with Past Septic and Silt Disposal

				Control Scenario		Intruder Scenario	
	Half Life (years)	Total Accumulated Activity as of 7/15/99 (uCi/acre)	Total Accumulated Activity as of 2013 uCi/acres	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Mn-54	0.86	0.196	2.31E-06	8.67E-10	4.46E-10	2.36E-08	7.22E-09
Co-60	5.27	6.855	1.26E+01	9.02E-03	6.68E-03	4.01E-01	1.14E-01
Zn-65	0.67	0.233	1.15E-07	1.86E-09	1.18E-09	2.17E-09	1.43E-09
Cs-137	30.17	31.924	1.05E+02	2.78E-01	7.34E-02	7.30E-01	4.03E-01
Cs-134	2.065	0.005	4.92E-05	1.56E-07	6.30E-08	5.95E-07	4.60E-07
			Total:	2.87E-01	8.01E-02	1.13E+00	5.17E-01
			Dose Limit:	1	1	5	5
			% of Dose Limit:	28.72%	8.01%	22.62%	10.34%

Table 10 (Scenario IV)

Dose Impact from Past Disposals through 7/15/99 Plus all Annual Projected Disposals of Septic, Silt and Soil

Control Scenario:	Half-Life (years)	Projected Total Activity on plot Decayed to 2013 All Paths together (uCi/acre)	Maximum Organ Dose Factor (mrem/yr/uCi/acre)	Whole Body Dose Factor (mrem/yr/uCi/acre)	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Mn-54	0.86	0.14	3.75E-04	1.93E-04	5.25E-05	2.70E-05
Co-60	5.27	21.85	7.17E-04	5.31E-04	1.57E-02	1.16E-02
Zn-65	0.67	0.22	1.62E-02	1.03E-02	3.56E-03	2.27E-03
Cs-137	30.17	144.10	2.66E-03	7.02E-04	3.83E-01	1.01E-01
Cs-134	2.065	0.02	0.00318	0.00128	6.36E-05	2.56E-05
				Total Dose	4.03E-01	1.15E-01
				Dose Limit:	1	1
				% of Dose limit:	40.27%	11.51%

Intruder Scenario:	Half-Life (years)	Projected Total Activity on plot Decayed to 2013 All Paths together (uCi/acre)	Maximum Organ Dose Factor (mrem/yr/uCi/acre)	Whole Body Dose Factor (mrem/yr/uCi/acre)	Maximum Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)
Mn-54	0.86	0.14	1.02E-02	3.12E-03	1.43E-03	4.37E-04
Co-60	5.27	21.85	3.19E-02	9.09E-03	6.97E-01	1.99E-01
Zn-65	0.67	0.22	1.89E-02	1.25E-02	4.16E-03	2.75E-03
Cs-137	30.17	144.10	6.98E-03	3.85E-03	1.01E+00	5.55E-01
Cs-134	2.065	0.02	1.21E-02	9.36E-03	2.42E-04	1.87E-04
				Total Dose	1.71E+00	7.57E-01
				Dose Limit:	5	5
				% of Dose limit:	34.17%	15.14%

Table 11

Summary of Dose Impacts Associated with Different Disposal Scenarios

	Control Period Dose Impact **DOSE LIMIT: 1mrem/yr**		Post Control Dose Impact **DOSE LIMIT: 5 mrem/yr**	
	Whole Body Dose (mrem/yr)	Critical Organ Dose (mrem/yr)	Whole Body Dose (mrem/yr)	Critical Organ Dose (mrem/yr)
SCENARIO I Past disposals only (septic and Cooling tower silt) through July 15, 1999.	2.85E-02 (2.85% of limit)	9.37E-02 (9.37% of limit)	9.90E-02 (1.98% of limit)	1.96E-01 (3.92% of limit)
SCENARIO II Past disposals plus one time addition of 25.5 m3 soil	3.26E-02 (3.26% of limit)	1.08E-01 (10.8% of limit)	1.15E-01 (2.30% of limit)	2.27E-01 (4.54% of limit)
SCENARIO III Past disposals plus existing 25.5m^3 and projected 28.3 m3 annual soil additions	8.01E-02 (8.01% of limit)	2.87E-01 (28.7% of limit)	5.17E-01 (10.3% of limit)	1.13E+00 (22.6% of limit)
SCENARIO IV Past disposals plus Future disposals of soil / septic / silt.	1.15E-01 (11.5% of limit)	4.03E-01 (40.2% of limit)	7.57E-01 (15.1% of limit)	1.71E+00 (34.2% of limit)