ENGINEERING DESIGN FILE

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5. Summary:
The purpose of this EDF is to estimate the source term of the Engineering Test Reactor (ETR) complex above grade level, from grade level to 3 feet below grade, from grade level to 10 feet below grade, and the source term below grade level (to the bottom of the concrete slab of the lowest level for each building in the ETR complex).

6. Review (R) and Approval (A) and Acceptance (Ac) Signatures:
(See instructions for definitions of terms and significance of signatures.)

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ETR Complex Activity vs. Depth

1. INTRODUCTION

This EDF estimates the source term of the Engineering Test Reactor (ETR) complex above grade level, from grade level to 3 feet below grade, from grade level to 10 feet below grade, and the source term below grade level (to the bottom of the concrete slab of the lowest level for each building in the ETR complex).

In the CERCLA risk assessment process, various “scenarios” are used in the exposure assessment calculations. Each scenario usually deals with different portions of a site source term. The ETR and MTR Engineering Evaluation and Cost Analysis (EE/CA) is looking at the source term for three scenarios.

- The first scenario is the no action scenario that includes all chemical and radiological source term both above and below ground.
- The grade to 3 foot interval is roughly equivalent to an industrial scenario and also corresponds to the current proposed end state of removal of all buildings and structures to 3 foot below ground surface.
- The grade to 10 foot interval is used to determine the residential scenario risk where a future hypothetical resident builds a house, excavates down to 10 ft. to install a basement and the excavated soils become available for uptake by the residents over their lifetime.

All above and below ground surface source terms are used to calculate contaminant infiltration to the aquifer and the subsequent risk of uptake to a receptor through ingestion or inhalation of ground water that is drawn to the surface through a well.

2. BUILDINGS

Buildings associated with the ETR complex that are scheduled for D&D characterized in this EDF include the following:

- TRA-642—Reactor building: The reactor building has three main levels, as shown in Figure 1: the main hall, the console level, and the basement with the loop cubicles and a sub-pile room. Other areas of interest in the building include pipe tunnel and the control rod access room.

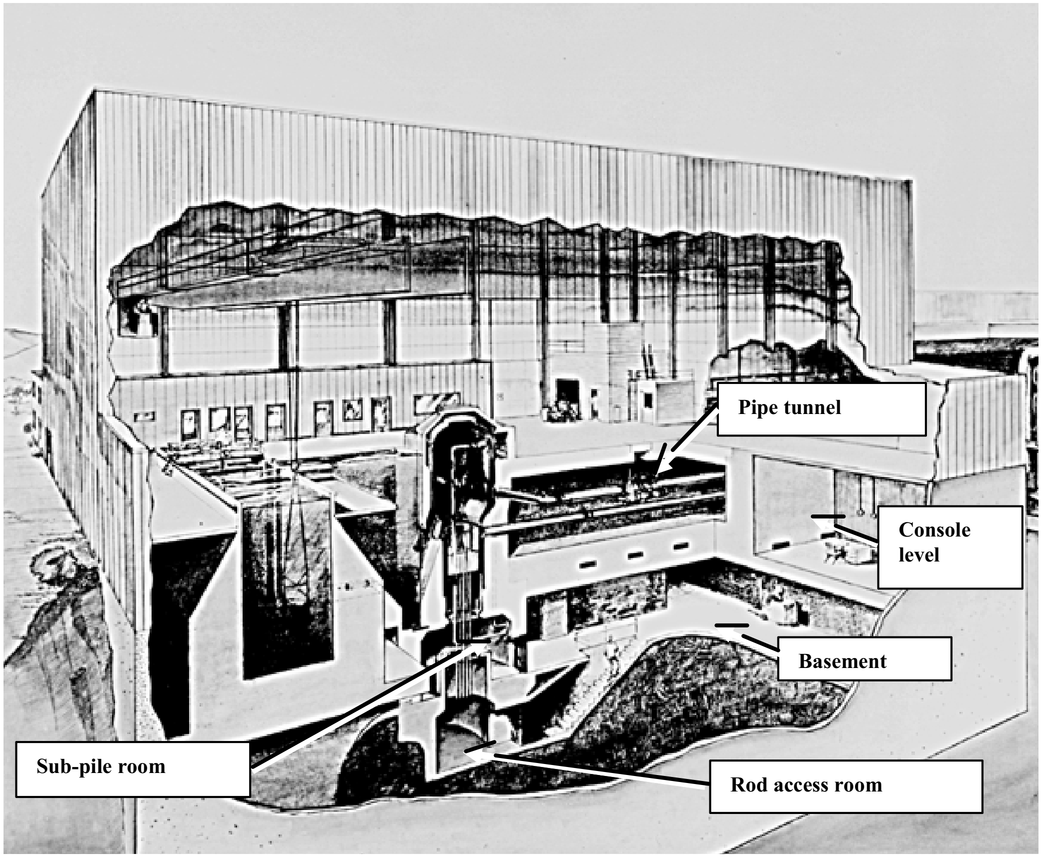

Figure 1. Rendering of the Reactor building configuration looking north.

- TRA-643—Compressor building: The compressor building housed the equipment used to supply large quantities of heated, hydrocarbon-free air to various experiments. In the building (Figure 2) is the process control room (at the east end) that was used to control all plant services to the reactor and the sample laboratory (on the south side) that was used to conduct chemistry samples on the reactor primary and secondary coolant systems. A floor plan of the compressor building is shown in Figure 3

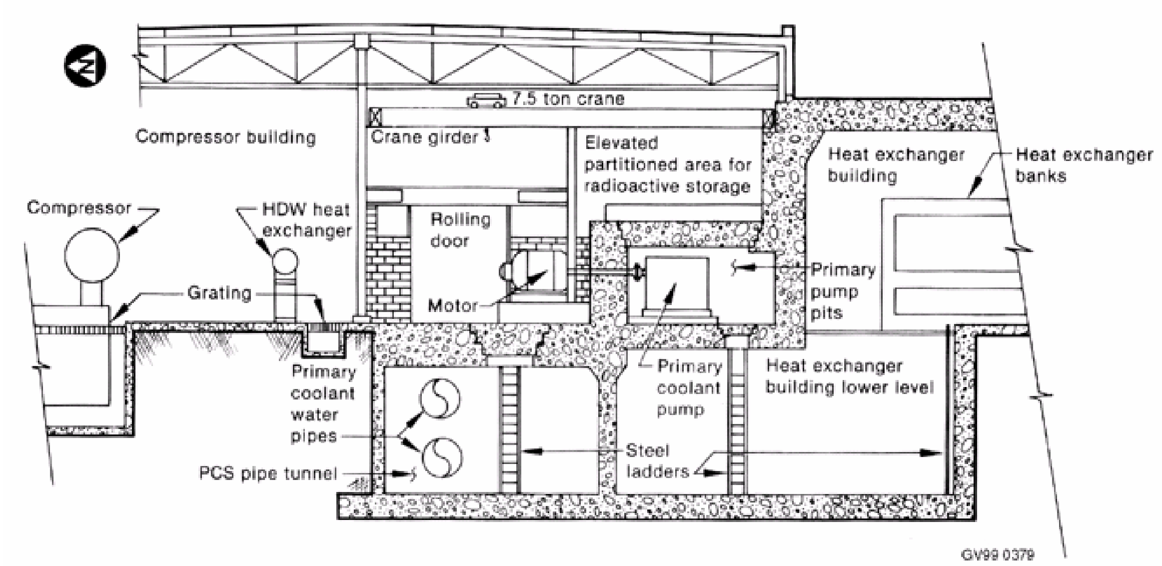

Figure 2. Elevation View of TRA-643.

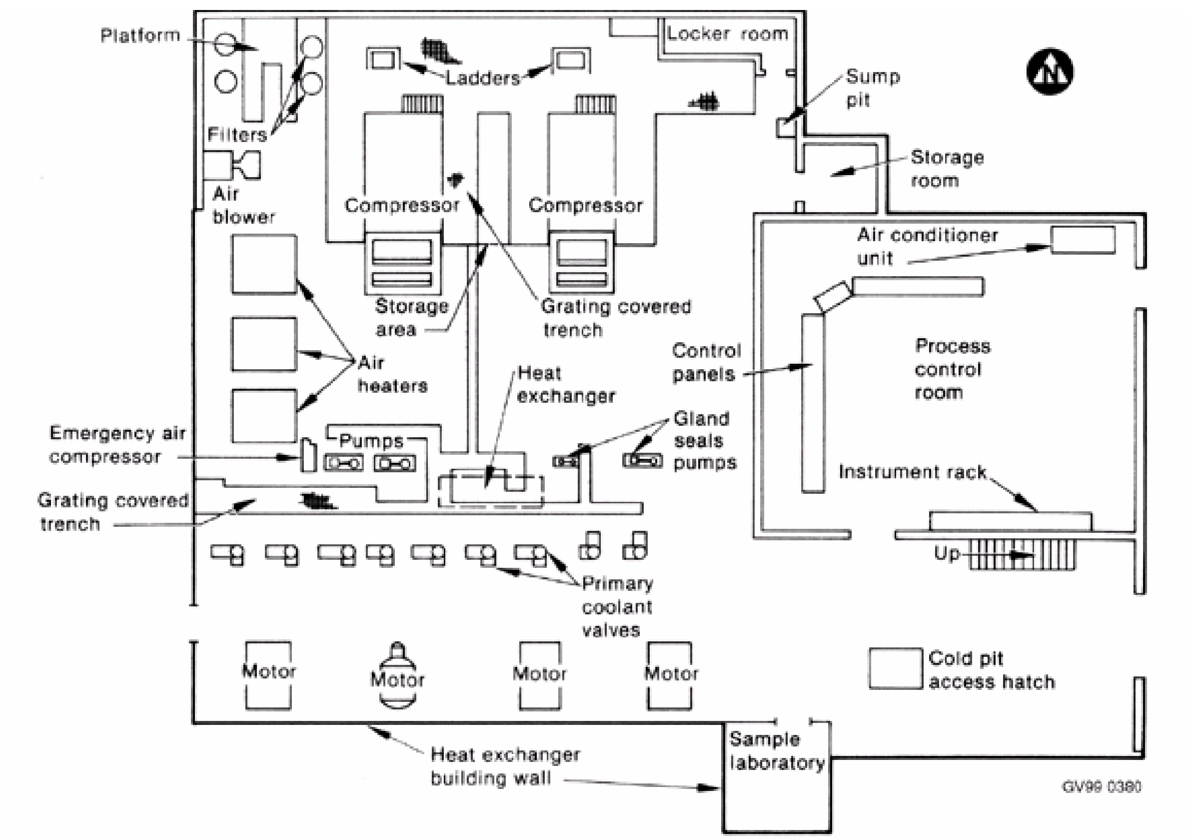

Figure 3. Cutaway drawing of the ETR compressor building (TRA-643).

- TRA-644—Heat Exchanger Building: The heat exchanger building is adjacent to and east of the reactor building and south of the compressor building. The building includes (a) a main room and lower level, (b) a demineralizer wing (valve room and tank room), (c) a degassing tank room, (d) a cubicle exhaust booster blower room, and (e) a secondary pipe pit. The primary function of the heat exchanger building main room was to house the 12 primary coolant/secondary coolant system heat exchangers and associated piping. The primary-to-secondary heat exchangers each contain 1700 1.6-cm (5/8-in) OD tubes. Figure 4 shows an artists cutaway rendering of the heat exchanger building.

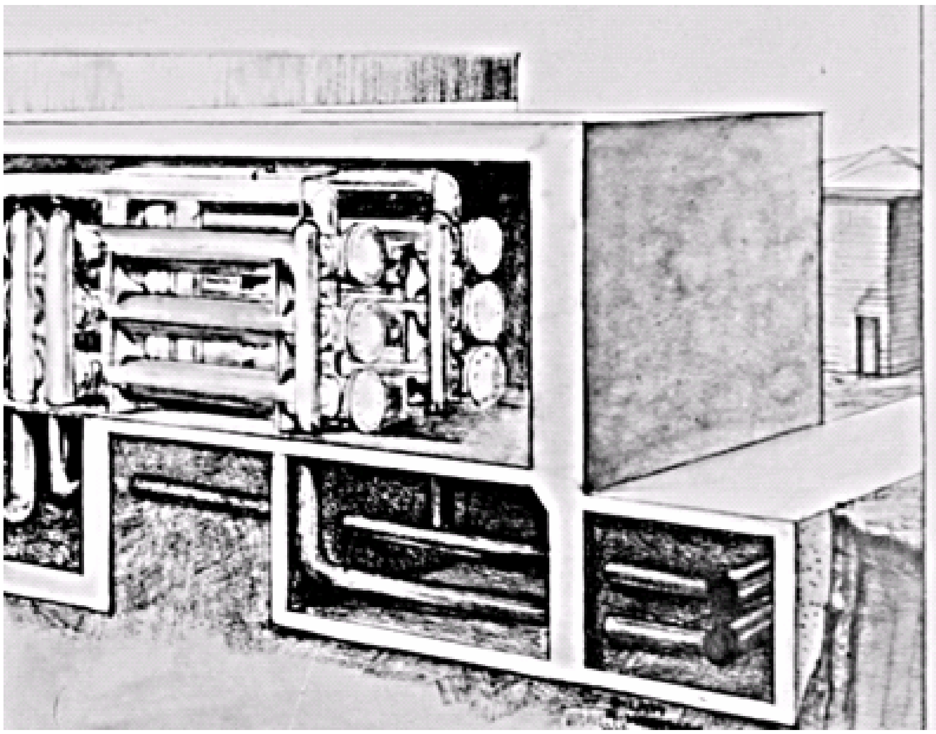

Figure 4. Artist's cutaway rendering of the ETR heat exchanger building.

- TRA-648—Electrical Building: The electrical building (Figure 5) includes two elevations consisting of a ground floor and a basement cable vault. TRA-648 houses the major electrical equipment for the ETR facility. Equipment includes switchgear, the emergency diesel generator No. 1, five motor-generator units, and the station battery bank.

Building: TRA-648

Name: ETR Electrical Building

Figure 5. TRA-648 electrical building.

- TRA-704—Primary Filter Vault: This underground vault, located to the north of the reactor building, houses the primary filters associated with the Loop-99 experimental air system.
- TRA-706—Delay Tank Vault: This underground vault, located east of the compressor building, houses the delay tanks. The delay tanks are baffeled tanks used to delay exhaust flow to allow for the decay of radionuclides in the exhaust air.
- TRA-705—Secondary Filter Vault. This underground vault, located to the south of the filter plant (TRA-755), houses the secondary filters associated with the Loop-99 experimental air system.

3. SOURCE TERM INFORMATION

TRA-642—Reactor Building:

Reactor

- **Activity:** Values for reactor activity, due to activation, are taken from EDF-6133 (reference 2), *ETR Reactor Source Term and External Dose Rates.* EDF-6133 calculated the reactor source term from a MicroShield model based on dose rate information taken from inside of the reactor.

  Reactor activity, due to surface contamination, is derived based on the source term data calculated in EDF-6291 (reference 4), *Radiological Characterization of the ETR Complex Internal Surfaces.* EDF-6291 calculated a source term for equipment interior surfaces based on lab analysis and interior contamination levels.
- **Location Relative to Grade:** The locations of the reactor internal components, relative to grade, are approximated based on the information contained in Figure 2 of the Fundamentals in the Operation of Nuclear test Reactors, Vol. 3 Engineering Test Reactor Design and Operation (reference 8).
- **Contaminated Surface Area:** Values for the exterior surface area of the reactor are taken from EDF-4986 (reference 5), *Radiological Characterization of RTE for Disposal*. Values for the interior surface area of the reactor are obtained from ETR Engineering (attachment 1)

Building Surfaces

- **Activity:** Activities due to surface contamination for these areas are based on lab analysis and levels of surface contamination documented EDF-6138 (reference 3), *Radiological Characterization of the ETR Complex External Surfaces*
- **Location Relative to Grade:** The locations, relative to grade level, for the various contaminated surfaces are taken from drawings 101206, *Reactor Bldg. Utility Piping Plan Below First Floor*, and 101221, *Reactor Building Experimental Air Exhaust – Details.*
- **Contaminated Surface Area:** Surface areas associated with building TRA-642 are taken from EDF-4986 (reference 5), *Radiological Characterization of ETR for Disposal*. When this document did not provide the required information on a specific area, the surface areas used in HAD-200 (reference 6), *ETR Facility Hazard Categorization,* are used.

Contaminated Piping

- **Activity:** Activities due to surface contamination on the interior surfaces of piping and equipment are based on the lab analysis and characterization information contained in EDF-291 (reference 4), *Radiological Characterization of the ETR Complex Internal Surfaces.*
- **Location Relative to Grade and Surface Areas:** Information concerning the surface areas and locations relative to grade for the various piping systems and associated components were provided by ETR Engineering (attachment 1)

TRA-643—Compressor Building

Building Surfaces

- **Activity:** Activities due to surface contamination for these areas are based on lab analysis and levels of surface contamination documented EDF-6138 (reference 3), *Radiological Characterization of the ETR Complex External Surfaces*
- **Location Relative to Grade:** All contaminated surfaces associated with this building are located above grade level.
- **Contaminated Surface Area:** Surface areas associated with building TRA-643 are taken from EDF-4986 (reference 5), *Radiological Characterization of ETR for Disposal*.

<u>TRA-644—Heat Exchanger Building</u>

Building Surfaces

- **Activity:** Activities due to surface contamination for these areas are based on lab analysis and levels of surface contamination documented EDF-6138 (reference 3), *Radiological Characterization of the ETR Complex External Surfaces*
- **Location Relative to Grade:** The locations, relative to grade level, for the various contaminated surfaces are taken from drawings 101294, *Heat Exchanger Building Plan & Sections.*
- **Contaminated Surface Area:** Surface areas associated with building TRA-644 are taken from EDF-4986 (reference 5), *Radiological Characterization of ETR for Disposal*. When this document did not provide the required information on a specific area, the surface areas used in HAD-200 (reference 6), *ETR Facility Hazard Categorization,* are used.

Contaminated Piping

- **Activity:** Activities due to surface contamination on the interior surfaces of piping and equipment are based on the lab analysis and characterization information contained in EDF-291 (reference 4), *Radiological Characterization of the ETR Complex Internal Surfaces.*
- **Location Relative to Grade and Surface Areas:** Information concerning the surface areas and locations relative to grade for the various piping systems and associated components were provided by ETR Engineering (attachment 1)

<u>TRA-648—Electrical Building</u>

This building contains neither contaminated surfaces nor contaminated piping. No source term needed to be calculated for this building.

<u>TRA-704—Primary Filter Vault</u>

- **Activity:** Activities due to surface contamination on the vault surfaces are based on the lab analysis and characterization information contained in , EDF-5965, *Radionuclide Inventory for Two ETR Filters From TRA-705 Vault*.
- **Location Relative to Grade and Surface Areas:** Information concerning the surface area and location relative to grade for this filter vault is taken from Drawing 630043, *TRA D&D Isolation Design Packages for Structures 704, 705, 706, 753, and & 755.*

<u>TRA-705—Secondary Filter Vault</u>

- **Activity:** Activities due to surface contamination on the vault surfaces are based on the lab analysis and characterization information contained in, EDF-5965, *Radionuclide Inventory for Two ETR Filters From TRA-705 Vault*.
- **Location Relative to Grade and Surface Areas:** Information concerning the surface area and location relative to grade for this filter vault is taken from Drawing 630043, *TRA D&D Isolation Design Packages for Structures 704, 705, 706, 753, and & 755.*

TRA-706—Delay Tank Vault

- **Activity:** Activities due to surface contamination on the vault surfaces are based on the lab analysis and characterization information contained in, EDF-5965, *Radionuclide Inventory for Two ETR Filters From TRA-705 Vault.*
- **Location Relative to Grade and Surface Areas:** Information concerning the surface area and location relative to grade for this vault is taken from Drawings 102071, *Plot Plan Pits – Location of Trenches and delay Tanks,* and 630041, *TRA D&D Isolation design Packages for structures 704, 705, 706, 753, and 755.*

4. LAB DATA

Source term data contained in EDF-5965, which is used to develop a source term for the filter vaults and delay tank vaults, were based on information obtained from INTEC Radiochemistry Final Report for ETR Stack Log # 05-01311 dated March 10, 2005.

Source term data contained in EDF-6138 used to develop source terms for contaminated exterior surfaces were based on information contained in the RTC (Reactor Technology Complex) Radioanalytical Laboratory reports #CCN 201846 and CCN-202231

Source term data contained in EDF-6291 used to develop source terms for contaminated piping and equipment were based on information contained in lab report SDG Number TRA77201RN.

Table 1 below summarizes this lab data. Only data that was statistically positive (activity greater than two standard deviations) and greater than the minimum detectable activity were used.

Table 1. Lab Data.

Nuclide	EDF-5965 Sample Results pCi/sample	EDF-6138 Sample Results pCi/sample	EDF-6291 Sample Results pCi/g
Ag108m		8.10E+01	
Am241	4.77E+01		8.99E+02
C14			1.44E+03
Co60	2.87E+03	1.61E+03	2.61E+06
Cs137	2.48E+04	1.36E+04	1.87E+04
Fe55			3.55E+06
Ni59			6.69E+04
Ni63		9.82E+02	6.38E+06
Pu238	1.19E+01	2.07E+00	1.03E+03
Pu239	9.80E+01	2.62E+00	1.60E+03
Pu241	1.38E+03		
Sr90	1.72E+03	7.13E+01	1.75E+04
U233/Np237		1.65E-01	1.57E+02
U234	3.96E+00		
U235	2.70E-01		4.21E+00
U238	8.80E+00		

5. ASSUMPTIONS

- Grade level was assumed to be at 96' 6" for all buildings. (the main floor level of Building TRA-642). The 96' 6" dimension is based on the methodology used to specify elevations on the Material Test Reactor (MTR). Fundamentals in the Operation of Nuclear Test Reactors, Vol. 2 Materials Testing Reactor Design and Operation (reference 10), states "An arbitrary and convenient method for indicating relative elevations of parts of the reactor was utilized. By choosing elevation 100 ft 0 in. for the core horizontal centerline, the first floor elevation is 96 ft 6 in…" this manual goes on to state that "All elevations may be converted to sea level datum by adding 4828.26 ft."

- EDF-5965 utilized samples taken from the ETR exhaust stack to develop a source term for use in the filters up-stream of the stack. Calculations performed assume that the same radionuclides, in the relative quantities identified on the lab reports, are on the surfaces of the vault walls (i.e. the surfaces became contaminated due to work activities on the filters).
- EDF-6138 utilized hundreds of swipe samples to develop a source term for the complex external surfaces. Since EDF-6138 used the average of all the lab sample results taken throughout the ETR complex, it is reasonably assumed that the same nuclides in the relative quantities identified on the lab reports exist on all contaminated surfaces of the ETR complex.
- EDF-6291 results were based on a sample of corrosion products removed from the primary system. The same radionuclides in the same relative quantity are assumed to exist in all of the contaminated piping and equipment.
- Survey results for loose surface contamination levels less than the INL/ICP Radiological Control Manual, Table 2-2 limit of 1000 dpm/100 cm^2 are not recorded. It is not possible to determine how far below 1000 dpm/100 cm^2 the survey results actually were. Surface contamination in areas documented as less than 1000 dpm/100 cm^2 are conservatively assumed to have loose surface contamination levels equal to 1000 dpm/100 cm^2.
- 49 CFR 173 requires the use of an assumed swipe efficiency (in the absence of the determination of actual swipe efficiency) of 10% for waste characterization. Surface contamination levels used in this EDF include a 10% swipe efficiency.
- For areas in the ETR complex were the background radiation levels are low enough to allow the performance of direct (total) contamination surveys, the direct (total) contamination value is less than 10 times the loose surface contamination value. It is assumed for source term determinations in this EDF that total contamination is equivalent to 10 times the loose surface contamination values.
- It is assumed that only Cs137, Co60, Sr90, and Ag108m activity contribute to the beta/gamma contamination survey results.

6. METHODOLOGY

External Surfaces:

The contribution to the measurable beta/gamma contamination is determined, based on lab sample results, for Cs137, Co-60, Sr-90, and Ag-108m. To obtain the percentage that each of the radionuclides contributes to the measurable activity, the activity of each radionuclide is divided by the total activity of Cs137, Co-60, Sr90 and Ag108m. These results, when multiplied by the measured survey result, give the quantity (in dpm/measured dpm for each of these radionuclides. Table 2 shows the results of these calculations.

Other nuclides that were identified on the lab report referenced in EDF-6133 were then normalized to either Cs-137 (for nuclides associated with fission) or Co-60 (for nuclides associated with activation). I-129 and Tc-99 were not identified in the lab results but were identified in a previous sampling effort (see reference 11). I-129 and Tc-99 are included in the analysis to account for these radionuclides The results of these calculations can be seen in Table 2 below.

Table 2. Percent contribution and normalized results.

Nuclide	Percent Contribution to Measured Result	Normalized to Cs137	Normalized to Co60
Cs137	88.53%		
Co60	10.48%		
Sr90	0.47%		
Agm108	0.53%		
U233		1.22E-05	
Pu238		1.52E-04	
Pu239		1.93E-04	
Ni63			6.11E-01
C14			6.40E-02
Tc99		9.03E-04	
I129		5.87E-04	

Total activities for the measurable radionuclides at a given location are determined by multiplying the contamination survey results by the percent contribution to these survey results by the particular nuclide and the total surface area of that location.

These activities of the remaining radionuclides are determined by the product of the measurable nuclide activity and their normalized value.

See Appendix 2 for a sample calculation

Filter/Delay Tank Vaults

The activities of the filter pits (TRA-705, TRA-706, and TRA-704) where calculated in a similar fashion to the external surfaces with the exception that the lab results identified in EDF-5965 were used to establish the percent contribution and normalized results. Table 3 shows the normalized lab results.

Table 3. Percent contribution and normalized result.

Nuclide	Percent Contribution to Measured Result	Normalized to Cs137
Am241		1.92E-03
Co60	9.77%	
Cs137	84.38%	
Pu238		4.80E-04
Pu239		3.95E-03
Pu241		5.56E-02
Sr90	5.85%	
U234		1.60E-04
U235		1.09E-05
U238		3.55E-04

Interior Surfaces

Activities, due to surface contamination, for the internals of tanks, piping, equipment, and the reactor are based on the activities (Ci/cm^2) identified in EDF-6291. EDF-6291 utilized a MicroShield model of a contaminated section of 24” ID pipe (the most common size of pipe in the system) and actual radiation survey data to convert the lab results into a Ci value for each radionuclide.

This calculated activity was divided by the total contaminated surface area of the model to obtain a quantity of Ci/cm^2 for each radionuclide. Table 4 shows the results of this MicroShield analysis.

This specific quantity of each radionuclide is then multiplied by the total surface area for each system and the percentage of that system in a particular grade level (above grade, 0–3 ‘, etc.). Note: the surface area was increased over the value provided by engineering for the above grade primary piping surface area in TRA-644 to account for the estimated surface areas of the heat exchangers.

Table 4. Lab result, MicroShield result, and Ci/cm^2 for each radionuclide.

Nuclide	Lab Result pCi/g	MicroShield Results (Ci)	24” OD (Ci/cm^2)
Am241	8.99E+02	6.24E-08	1.1E-12
C14	1.44E+03	1.00E-07	1.8E-12
Co60	2.61E+06	1.81E-04	3.2E-09
Cs137	1.87E+04	1.30E-06	2.3E-11
Fe55	3.55E+06	2.47E-04	4.4E-09
Ni59	6.69E+04	4.64E-06	8.2E-11
Ni63	6.38E+06	4.42E-04	7.8E-09
Pu238	1.03E+03	7.16E-08	1.3E-12
Pu239	1.60E+03	1.11E-07	2.0E-12
Sr90	1.75E+04	1.21E-06	2.1E-11
U233	1.57E+02	1.09E-08	1.9E-13
U235	4.21E+00	2.92E-10	5.2E-15

See Appendix 2 for a sample calculation.

Reactor Activation

The reactor activation source term was distributed to each grade location based on the analysis performed in EDF-6133 and the reactor component elevations shown in Figure 2 of the Fundamentals in the Operation of Nuclear test Reactors, Vol. 3 Engineering Test Reactor Design and Operation. Since the “above grade” and the “3’ below grade” locations are not within 1 m of the reactor core, the only activity that is assumed to be provided by the reactor is due to surface contamination.

EDF-6133 characterized the reactor based on 7 TLDs, spaced in 2’ intervals, place vertically in side the reactor with the lowest TLD placed 2” above the grid plate (at the bottom of the core). The TLD locations were identified by station numbers with the TLD located just above the grid plate being Station 1.

For the 10’ below grade location, the source terms calculated for TLD Stations #5, #6, #7 of EDF-6133 were assigned to this source term.

For the below grade location, the entire reactor source term of EDF-6133 was used.

7. RESULTS

The “above grade” source term is shown in table 1 below. Values shown below include contaminated interior and exterior surfaces. Two values for each radionuclide are shown. The first value includes the activity added by the reactor and the second value has the reactor activity removed.

Table 1. Above grade.

	Ag-108m (Ci)	Am241 (Ci)	C-14 (Ci)	Co-60 (Ci)	Cs-137 (Ci)	Fe-55 (Ci)	I-129 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U-233 (Ci)	U-235 (Ci)	Total (Ci)
Total =	1.77E-05	7.91E-05	1.49E-04	2.30E-01	4.62E-03	3.13E-01	1.74E-06	5.89E-03	5.61E-01	9.13E-05	1.42E-04	1.56E-03	2.68E-06	1.39E-05	3.70E-07	1.12E+00
Total w/o Reactor =	1.77E-05	7.88E-05	1.49E-04	2.30E-01	4.60E-03	3.12E-01	1.74E-06	5.87E-03	5.59E-01	9.10E-05	1.41E-04	1.55E-03	2.67E-06	1.38E-05	3.69E-07	1.11E+00

The “grade to 3’ below grade” source term is shown in Table 2 below. Values shown below include contaminated interior and exterior surfaces. Two values for each radionuclide are shown. The first value includes the activity added by the reactor and the second value has the reactor activity removed.

Table 2. Grade level to 3’ below grade.

	Ag-108m (Ci)	Am241 (Ci)	C-14 (Ci)	Co-60 (Ci)	Cs-137 (Ci)	Fe-55 (Ci)	I-129 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-241 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U-233 (Ci)	U-235 (Ci)	U-238 (Ci)	Total (Ci)
Total =	3.10E-06	3.58E-07	4.48E-06	1.06E-03	5.34E-04	1.35E-03	3.05E-07	2.55E-05	2.47E-03	4.76E-07	7.42E-07	4.48E-07	9.95E-06	4.69E-07	6.75E-08	1.69E-09	2.85E-09	5.46E-03
Total w/o Reactor =	3.07E-06	2.47E-07	4.27E-06	7.35E-04	5.28E-04	9.16E-04	3.02E-07	1.72E-05	1.68E-03	3.48E-07	5.44E-07	4.48E-07	7.78E-06	4.65E-07	4.81E-08	1.17E-09	2.85E-09	3.89E-03

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The "grade to 10' below grade" source term is shown in Table 3 below. Values shown below include contaminated interior and exterior surfaces. Two values for each radionuclide are shown. The first value includes the activity added by the reactor and the second value has the reactor activity removed.

Table 3. Grade level to 10' below grade.

	Ac227 (Ci)	Ag-108m (Ci)	Ag-110m (Ci)	Am241 (Ci)	Am243 (Ci)	Be10 (Ci)	C-14 (Ci)	Ce-144 (Ci)	Cl-36 (Ci)	Cm243 (Ci)	Cm244 (Ci)	Cm245 (Ci)	Cm246 (Ci)	Cm247 (Ci)
Total =	8.49E-09	2.04E-03	6.20E-13	1.53E-03	2.32E-05	3.13E-03	1.11E-01	1.90E-11	1.06E-03	4.23E-06	2.69E-03	5.07E-07	5.60E-07	3.95E-12
Total w/0 Reactor =		7.75E-06		1.13E-05			2.76E-05							

	Cm248 (Ci)	Co60 (Ci)	Cs134 (Ci)	Cs-137 (Ci)	Eu152 (Ci)	Eu154 (Ci)	Fe55 (Ci)	H3 (Ci)	I129 (Ci)	Mn54 (Ci)	Nb94 (Ci)	Ni59 (Ci)	Ni63 (Ci)	Np237 (Ci)
Total =	7.08E-11	1.66E+01	2.47E-05	2.44E-02	1.53E-03	8.77E-03	4.52E-02	2.76E+02	8.06E-07	2.69E-08	4.05E-02	1.11E+00	2.03E+02	1.80E-08
Total w/0 Reactor =		3.24E-02		1.66E-03			4.38E-02		7.62E-07			8.24E-04	7.87E-02	

	Pa231 (Ci)	Pb210 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Pu-244 (Ci)	Ra226 (Ci)	Ru106 (Ci)	Sb125 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	Th228 (Ci)
Total =	1.24E-08	5.78E-13	7.15E-04	1.73E-04	1.87E-04	1.52E-02	2.39E-06	2.24E-12	9.34E-13	2.63E-09	5.53E-05	7.32E-03	5.44E-05	1.50E-06
Total w/0 Reactor =			1.30E-05	2.05E-05		7.53E-06						2.32E-04	1.17E-06	

	Th229 (Ci)	Th230 (Ci)	Th232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)	Zn65 (Ci)	Total (Ci)
Total =	1.01E-08	9.83E-11	1.72E-08	1.45E-06	4.90E-06	2.58E-07	5.72E-08	6.06E-09	1.20E-07	1.43E-12	4.97E+02
Total w/0 Reactor =					1.98E-06		5.33E-08		4.80E-08		1.58E-01

The "below grade" source term is shown in table 4 below. Values shown below include contaminated interior and exterior surfaces. Two values for each radionuclide are shown. The first value includes the activity added by the reactor and the second value has the reactor activity removed.

Table 4. Below grade.

	Ac227 (Ci)	Ag-108m (Ci)	Ag-110m (Ci)	Am241 (Ci)	Am243 (Ci)	Be10 (Ci)	C-14 (Ci)	Ce-144 (Ci)	Cl-36 (Ci)	Cm243 (Ci)	Cm244 (Ci)	Cm245 (Ci)	Cm246 (Ci)	Cm247 (Ci)
Total	1.01E-06	2.43E-01	7.40E-11	1.82E-01	2.76E-03	3.73E-01	1.33E+01	2.26E-09	1.26E-01	5.04E-04	3.20E-01	6.05E-05	6.68E-05	4.71E-10
Total w/o Reactor		9.93E-05		5.31E-05			5.24E-04							

	Cm248 (Ci)	Co60 (Ci)	Cs134 (Ci)	Cs-137 (Ci)	Eu152 (Ci)	Eu154 (Ci)	Fe55 (Ci)	H3 (Ci)	I129 (Ci)	Mn54 (Ci)	Nb94 (Ci)	Ni59 (Ci)	Ni63 (Ci)	Np237 (Ci)
Total	8.45E-09	1.97E+03	2.95E-03	2.75E+00	1.82E-01	1.05E+00	1.65E-01	3.29E+04	2.66E-05	3.21E-06	4.83E+00	1.32E+02	2.42E+04	2.15E-06
Total w/o Reactor		1.20E-01		4.63E-02			1.53E-01		2.23E-05			2.87E-03	2.78E-01	

	Pa231 (Ci)	Pb210 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Pu-244 (Ci)	Ra226 (Ci)	Ru106 (Ci)	Sb125 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	Th228 (Ci)
Total	1.48E-06	6.89E-11	8.37E-02	1.83E-02	2.23E-02	1.82E+00	2.84E-04	2.67E-10	1.11E-10	3.13E-07	6.60E-03	8.49E-01	6.38E-03	1.79E-04
Total w/o Reactor			5.38E-05	1.06E-04		4.18E-04						4.18E-03	3.43E-05	

	Th229 (Ci)	Th230 (Ci)	Th232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)	Zn65 (Ci)	Total (Ci)
Total	1.20E-06	1.17E-08	2.05E-06	1.73E-04	3.50E-04	3.07E-05	4.51E-07	7.23E-07	1.12E-05	1.71E-10	5.93E+04
Total w/o Reactor					8.42E-06		1.82E-07		2.67E-06		6.06E-01

The total source term (above and below grade) is shown in table 5 below. Values shown below include contaminated interior and exterior surfaces. Two values for each radionuclide are shown. The first value includes the activity added by the reactor and the second value has the reactor activity removed.

Table 5. Totals.

	Ac227 (Ci)	Ag-108m (Ci)	Ag-110m (Ci)	Am241 (Ci)	Am243 (Ci)	Be10 (Ci)	C-14 (Ci)	Ce-144 (Ci)	Cl-36 (Ci)	Cm243 (Ci)	Cm244 (Ci)	Cm245 (Ci)	Cm246 (Ci)
Above Grade		1.52E-05		7.91E-05			1.46E-04						
Above Grade w/o Reactor		1.51E-05		7.88E-05			1.46E-04						
Below Grade	1.01E-06	2.43E-01	7.40E-11	1.82E-01	2.76E-03	3.73E-01	1.33E+01	2.26E-09	1.26E-01	5.04E-04	3.20E-01	6.05E-05	6.68E-05
Below Grade w/o Reactor	0.00E+00	9.93E-05	0.00E+00	5.31E-05	0.00E+00	0.00E+00	5.24E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total =	1.01E-06	2.43E-01	7.40E-11	1.82E-01	2.76E-03	3.73E-01	1.33E+01	2.26E-09	1.26E-01	5.04E-04	3.20E-01	6.05E-05	6.68E-05
Total w/o reactor	0.00E+00	1.14E-04	0.00E+00	1.32E-04	0.00E+00	0.00E+00	6.69E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	Cm247 (Ci)	Cm248 (Ci)	Co60 (Ci)	Cs134 (Ci)	Cs-137 (Ci)	Eu152 (Ci)	Eu154 (Ci)	Fe55 (Ci)	H3 (Ci)	I129 (Ci)	Mn54 (Ci)	Nb94 (Ci)	Ni59 (Ci)
Above Grade			2.30E-01		4.19E-03			3.13E-01		1.49E-06			5.89E-03
Above Grade w/o Reactor			2.29E-01		4.17E-03			3.12E-01		1.49E-06			5.87E-03
Below Grade	4.71E-10	8.45E-09	1.97E+03	2.95E-03	2.75E+00	1.82E-01	1.05E+00	1.65E-01	3.29E+04	2.66E-05	3.21E-06	4.83E+00	1.32E+02
Below Grade w/o Reactor	0.00E+00	0.00E+00	1.20E-01	0.00E+00	4.63E-02	0.00E+00	0.00E+00	1.53E-01	0.00E+00	2.23E-05	0.00E+00	0.00E+00	2.87E-03
Total =	4.71E-10	8.45E-09	1.97E+03	2.95E-03	2.76E+00	1.82E-01	1.05E+00	4.78E-01	3.29E+04	2.81E-05	3.21E-06	4.83E+00	1.32E+02
Total w/o reactor	0.00E+00	0.00E+00	3.50E-01	0.00E+00	5.05E-02	0.00E+00	0.00E+00	4.64E-01	0.00E+00	2.38E-05	0.00E+00	0.00E+00	8.74E-03

	Ni63 (Ci)	Np237 (Ci)	Pa231 (Ci)	Pb210 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Pu-244 (Ci)	Ra226 (Ci)	Ru106 (Ci)	Sb125 (Ci)
Above Grade	5.61E-01				9.12E-05	1.41E-04							
Above Grade w/o Reactor	5.59E-01				9.09E-05	1.41E-04							
Below Grade	2.42E+04	2.15E-06	1.48E-06	6.89E-11	8.37E-02	1.83E-02	2.23E-02	1.82E+00	2.84E-04	2.67E-10	1.11E-10	3.13E-07	6.60E-03
Below Grade w/o Reactor	2.78E-01	0.00E+00	0.00E+00	0.00E+00	5.38E-05	1.06E-04	0.00E+00	4.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total =	2.42E+04	2.15E-06	1.48E-06	6.89E-11	8.38E-02	1.84E-02	2.23E-02	1.82E+00	2.84E-04	2.67E-10	1.11E-10	3.13E-07	6.60E-03
Total w/o reactor	8.38E-01	0.00E+00	0.00E+00	0.00E+00	1.45E-04	2.47E-04	0.00E+00	4.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	Sr-90 (Ci)	Tc-99 (Ci)	Th228 (Ci)	Th229 (Ci)	Th230 (Ci)	Th232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)	Zn65 (Ci)	Total (Ci)
Above Grade	1.55E-03	2.30E-06						1.39E-05		3.70E-07				1.12E+00
Above Grade w/o Reactor	1.55E-03	2.29E-06						1.38E-05		3.69E-07				1.11E+00
Below Grade	8.49E-01	6.38E-03	1.79E-04	1.20E-06	1.17E-08	2.05E-06	1.73E-04	3.50E-04	3.07E-05	4.51E-07	7.23E-07	1.12E-05	1.71E-10	5.93E+04
Below Grade w/o Reactor	4.18E-03	3.43E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.42E-06	0.00E+00	1.82E-07	0.00E+00	2.67E-06	0.00E+00	6.06E-01
Total =	8.50E-01	6.38E-03	1.79E-04	1.20E-06	1.17E-08	2.05E-06	1.73E-04	3.64E-04	3.07E-05	8.21E-07	7.23E-07	1.12E-05	1.71E-10	5.93E+04
Total w/o reactor	5.73E-03	3.66E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.23E-05	0.00E+00	5.51E-07	0.00E+00	2.67E-06	0.00E+00	1.72E+00

8. CONCLUSION

This EDF calculates the source term of the Engineering Test Reactor (ETR) complex above grade level, from grade level to 3 feet below grade, from grade level to 10 feet below grade, and the source term below grade level (to the bottom of the concrete slab of the lowest level for each building in the ETR complex).

This source term may be used in the various “scenarios” of the CERCLA risk assessment process for exposure assessment calculations. These “scenarios are as follows:

- The first scenario is the no action scenario that includes all chemical and radiological source term both above and below ground.
- The grade to 3 foot interval is roughly equivalent to an industrial scenario and also corresponds to the current proposed end state of removal of all buildings and structures to 3 foot below ground surface.
- The grade to 10 foot interval is used to determine the residential scenario risk were a future hypothetical resident builds a house, excavates down to 10 ft. to install a basement and the excavated soils become available for uptake by the residents over their lifetime.

All above and below ground surface source terms calculated in this EDF may be used to calculate contaminant infiltration to the aquifer and the subsequent risk of uptake to a receptor through ingestion or inhalation of ground water that is drawn to the surface through a well.

Tables 1 through 5 listed in the results section show the total source terms for various locations throughout the ETR complex. The calculations were based on the surface areas of the various locations and the analysis from lab results and calculations contained in other EDFs. The Excel spreadsheet listed in Attachment 3 show the values used to perform the calculations and the results.

9. REFERENCES

1. J. J. Lopez, 2005, EDF-5965, Radionuclide Inventory for Two ETR Filters From TRA-705 Vault, Idaho National Laboratory, Idaho Falls, Idaho.
2. C. A. Nesshoefer, 2005, EDF-6133, ETR Reactor Source Term and External Dose Rates, Idaho National Laboratory, Idaho Falls, Idaho.
3. C. A. Nesshoefer, 2005, EDF-6138, Radiological Characterization of the ETR Complex External Surfaces, Idaho National Laboratory, Idaho Falls, Idaho.
4. C. A Nesshoefer, 2005, EDF-6291, Radiological Characterization of the ETR Complex Internal Surfaces, Idaho National Laboratory, Idaho Falls, Idaho.
5. G. R. Longhurst et al., 2005, EDF-4986, Radiological Characterization of ETR for Disposal, Idaho National Laboratory, Idaho Falls, Idaho.
6. ETR Facility Hazard Characterization, 2002, HAD-200, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho.
7. C. Chambers, September 21, 2005, conversation with C. A. Nesshoefer, Idaho National Laboratory, Idaho Falls, Idaho.
8. R. J. Nertney et al., 1964, Fundamentals in the Operation of Nuclear Test Reactors Vol. 3, IDO-16871-3, Phillips Petroleum Company, Atomic Energy Division, Idaho Falls, Idaho.

9. Engineering Drawings 102071, 630040, 630043, 101294, 101206, 101221, & 630035

10. R. S. McPherson et al., 1963, Fundamentals in the Operation of Nuclear Test Reactors Vol. 2, IDO-16871-2, Phillips Petroleum Company, Atomic Energy Division, Idaho Falls, Idaho.

11. A. D. Coveleskie, September 3, 1997, Engineering Test Reactor (*ETR) Radiological Characterization*, EDF-TRA-007 (TRA-ATR-1145-R1), Idaho National Engineering Laboratory, Idaho Falls, Idaho.

10. ATTACHMENTS

1. Engineering Calculation for Piping Surface Areas

2. Sample Calculations

3. Excel Spreadsheet for Activity Calculations

Attachment 1, page 1 of 1
Engineering Calculation of Piping Surface Areas

ETR Contaminated Piping Inventory

Area Description	Volume ft^3	Estimated Piping Length ft	Surface Area ft^2	Elevation	Notes
Reactor Vessel	4914	N/A	1637	1	
Nozzle Trench	10	204	160	1	Assume 3" Average Diameter
Canal	64	1313	1030	4	Assume 3" Average Diameter
Console Floor	2	100	52	3	Assume 2" Average Diameter Warm Waste Feed From ETR-653
Reactor Basement (General Area)	1240	702	3306	4	Assume 18" Average Diameter
Waste Tank Pits	1343	380	1470	4	Assume 4"Average Pipe Diameter. Includes Warm and Cold (Decon) Waste Tanks
AGS Cubicle	3.1	569	149	4	Assume 1" Average Diameter
M-3 / P-7 Cubicles	831.17	1823	3531	4	Assume 4" Average Pipe Diameter and 18" Tank and Valve Diameter. Includes Pressurizers.
J-10 / L-10 Cubicles	N/A	N/A	N/A	4	
C-7 / M-13 / N-14 Cubicles	800	596	1935	4	Assume 2" Average Diameter
F-10 / H-10 Cubicles	657.33	2732	1091	4	Assume 4" Average Pipe Diameter and 18" Tank and Valve Diameter. Includes Surge Tank
L-12 / M-7	1469	2182	3830	4	Assume 4" Average Pipe Diameter and 18" Tank and Valve Diameter. Includes Pressurizers.
C-13 / G-16	651.5	120	1831	4	Assume 4" Average Pipe Diameter and 18" Tank and Valve Diameter.
Helium System Cubicles	N/A	N/A	N/A	4	
SLSF FS&R	N/A	N/A	N/A	4	
Control Rod Access Room	6	1101	288	4	Assume 1" Average Diameter
Subpile	119	1334	1869	4	Assume 4" Average Pipe Diameter and 18" Cooler Diameter.
GEEL Tunnel & Delay Tanks	16145	3823	13926	4	Assume 8" Average Diameter. Includes Delay Tanks
PCS Piping Tunnel	3713	267	4951	3,4	Assume 36" Pipe Diameter and 36" Valve Diameter
Compressor Building Main Room	N/A	N/A	N/A	2	
HX Bldg Bypass Demin Tank and Valve Room	1121	1796	2767	1	Assumes 4" Pipe Diameter. Resin Tanks Included.
HX Bldg Main Floor and Lower Level	10652	1760	12358	2,3,4	Assumes 24" Pipe Diameter. Heat Exchangers Included.
Degassing Room	1256	1590	1334	1	Assumes 2" Pipe Includes Degassing Tank
Secondary Pipe Trench	N/A	N/A	N/A	2,3,4	
Pump Pits	2064	413	3264	1	Assumes 24" Pipe Diameter.
Cubicle Exhaust Booster Blower Room	844	154	1232	1	Assumes 24" Pipe Diameter.

1 = Above Grade
2 = 0 – 4'
3 = 0 – 10''
4 = 10' and below

Attachment 2
Sample Calculations

The example shown below calculates the above grade source term due to surface contamination on the surfaces of main floor of TRA-642.

Given:

Surface area = 5353 m^2

Surface contamination levels = 1,000 dpm/100 cm^2 or 10,000 dpm/100 cm^2 with 10% swipe efficiency.

Lab Data =

Nuclide	EDF-6138 Sample Results pCi/sample
Ag108m	8.10E+01
Co60	1.61E+03
Cs137	1.36E+04
Ni63	9.82E+02
Pu238	2.07E+00
Pu239	2.62E+00
Sr90	7.13E+01
U233/Np237	1.65E-01

Contribution to beta/gamma contamination surveys:

The contribution to the beta/gamma contamination survey is determined by dividing the activity due to Cs-137 by the activities due to Cs-137, Co-60, Ag-108m, & Sr-90 (these are the only nuclides that are assumed to contribute to the survey results). This calculation is shown below:

$$\%Cs137 = \frac{Cs137}{Cs137 + Co60 + Ag180m + Sr90}$$

$$\%Cs137 = \frac{1.36*10^4}{1.36*10^4 + 1.61*10^3 + 8.10*10^1 + 7.13*10^1} = 88.53\%$$

The other radionuclide percentages, which are assumed to contribute to the beta/gamma survey, were also determined by dividing the nuclides activity by the total measurable activity. The result of these calculations are shown below:

Ag-108m = 0.53%

Co-60 = 10.48%

Sr-90 = 0.47%

Normalized Values:

The remaining radionuclides which are not accounted for on a standard beta gamma contamination survey where then normalized to either Cs-137 (for nuclides associated with fission) or Co-60 (for nuclides associated with activation. Tc-99 and I-129 were not identified on the lab report but were identified on a previous sampling effort. These two radionuclides are included in this analysis and their values are normalized to Cs-137. The normalization is performed by dividing the nuclides activity by by the activity due to Cs-137 or Co-60. For example, the normalized value for Pu-238 is determined as follows:

$$Norm\_Pu238 = \frac{Pu238_{Activity}}{Cs137_{Activity}} = \frac{2.07*10^{0}}{1.36*10^{4}} = 1.52*10^{-4}$$

The result of the normalization are shown below:

U-233 normalized to Cs-137	=	1.22E-05
Pu-238 normalized to Cs-137	=	1.52E-04
Pu-239 normalized to Cs-137	=	1.93E-04
Tc-99 normalized to Cs-137	=	9.03E-04
I-129 normalized to Cs-137	=	5.87E-04
Ni-63 normalized to Co-60	=	6.11E-01
C-14 normalized to Co-60	=	6.40E-02

TRA-642 Main Floor Activity due to Cs-137

The activity due to Cs-137 on the main floor is determined by multiplying the survey results by the contribution to these result due to Cs-137 then by the total surface area of the main floor. The following equation is used to perform this calculation

$$Cs137_{Activity} = Survey\_result * \%Cs137 * Area$$

Using the values for the survey result (including the swipe efficiency) of 10,000 dpm/100 cm^2 and a surface area of 5353 m^2 the equation becomes:

$$Cs137_{Activity} = \frac{10000dpm}{100cm^2} * 88.53\% * \frac{Ci}{2.22*10^{12}\,dpm} * 5353m^2 * \frac{10000cm^2}{m^2} = 2.13*10^{-3}\,Ci$$

The activities of the other nuclides that contribute to the beta/gamma survey were calculated in a similar fashion using their percent contribution to the results. The calculated values for these radionuclides are shown below:

Co-60 Activity	=	2.53E-4 Ci
Ag-108m Activity	=	1.27E-5 Ci
Sr-90 Activity	=	1.12E-5 Ci

Activity Determination Using Normalized Values:

The activity due to Pu-238 is determined by multiplying the calculated Cs-137 activity by the value of Pu 238 normalized to Cs-137. This calculation is shown below:

$$Pu238_{Activity} = Cs137_{activity} * Normalized\_Value = 2.13*10^{-3}\,Ci * 1.52*10^{-4} = 3.24*10^{-7}\,Ci$$

The activities for the other radionuclide were also determined using the normalized values. The results of these calculations are shown below:

C-14	=	1.62E-5
I-126	=	1.25E-6
Ni-63	=	1.54E-4
Pu-239	=	4.12E-7
Tc-99	=	1.93E-6
U-233	=	2.60E-8

Total Activity:

Total activity value for each location are determined by summing the results of all the individual radionuclide activities.

Other Activities:

Activities due to surface contamination inside of pipes and equipment were determined based on the MicroShield model developed in EDF-6291. The model was used to determine the total Curie content in a 10' length of 24" OD pipe based on radiation readings performed on that pipe section. The lab data used for the model and model results are shown below:

Nuclide	Lab Result pCi/g	MicroShield Results (Ci)
Am241	8.99E+02	6.24E-08
C14	1.44E+03	1.00E-07
Co60	2.61E+06	1.81E-04
Cs137	1.87E+04	1.30E-06
Fe55	3.55E+06	2.47E-04
Ni59	6.69E+04	4.64E-06
Ni63	6.38E+06	4.42E-04
Pu238	1.03E+03	7.16E-08
Pu239	1.60E+03	1.11E-07
Sr90	1.75E+04	1.21E-06
U233	1.57E+02	1.09E-08
U235	4.21E+00	2.92E-10

The MicroShield results were converted into an activity per unit area (Ci/cm^2) by dividing the results by the total surface area of the 10' pipe. The total surface are of the pipe section modeled was calculated to be 56,524.2 cm^2 giving the activity per unit area values shown in the table below:

Nuclide	(Ci/cm^2)
Am241	1.1E-12
C14	1.8E-12
Co60	3.2E-09
Cs137	2.3E-11
Fe55	4.4E-09
Ni59	8.2E-11
Ni63	7.8E-09
Pu238	1.3E-12
Pu239	2.0E-12
Sr90	2.1E-11
U233	1.9E-13
U235	5.2E-15

The activity due to contamination inside the piping system or component is then determined by multiplying these activity per unit area values by the surface area of the pipe of component and summing the results

Attachment 3
Calculation Spreadsheets

Source Term, Grade Level and Above

	Floor (ft2)	Wall (ft2)	Ceiling (ft2	Total (ft2)	Total (m2)	Source Document	Contamination level (dpm/100cm^2)	Ag-108m (Ci)	Am241 (Ci)	C-14 (Ci)	Co-60 (Ci)	Cs-137 (Ci)	Fe-55 (Ci)
Reactor Vessel				290.65	27	EDF-6138	10000	6.43E-08		8.16E-08	1.27E-06	1.08E-05	
Nozzle Trench	136.6	547		683.6	64	EDF-6138	10000	1.51E-07		1.92E-07	3.00E-06	2.53E-05	
Biological Shield (over cap)	490.87			490.87	46	EDF-6138	10000	1.09E-07		1.38E-07	2.15E-06	1.82E-05	
Canal		641.56		641.56	60	EDF-6138	10000	1.42E-07		1.80E-07	2.81E-06	2.38E-05	
Main Room	13525	28865.761	15232	57622.76	5353	EDF-6138	10000	1.27E-05		1.62E-05	2.53E-04	2.13E-03	
Storage Area TRA-643	639	634	639	1912	178	EDF-6138	10000	4.23E-07		5.37E-07	8.39E-06	7.08E-05	
Bypass valve room	95	326	95	516	48	EDF-6138	10000	1.14E-07		1.45E-07	2.26E-06	1.91E-05	
Tank room	68	288	68	424	39	EDF-6138	10000	9.38E-08		1.19E-07	1.86E-06	1.57E-05	
Main room TRA-644	1022	1332	1022	3376	314	EDF-6138	10000	7.47E-07		9.48E-07	1.48E-05	1.25E-04	
Degassing tank	43	211	43	297	28	EDF-6138	10000	6.57E-08		8.34E-08	1.30E-06	1.10E-05	
Primary pump pits	324	1152	324	1800	167	EDF-6138	10000	3.98E-07		5.05E-07	7.89E-06	6.67E-05	
Emergency shutdown pump pits	42	208	42	292	27	EDF-6138	10000	6.46E-08		8.20E-08	1.28E-06	1.08E-05	
Degassifier pump pits	40	203	40	283	26	EDF-6138	10000	6.26E-08		7.94E-08	1.24E-06	1.05E-05	
Nozzle Trench pipe				160	15	EDF-6291			1.64E-07	2.63E-07	4.77E-04	3.41E-06	6.48E-04
Piping in Bypass Demin Tank & Valve Room				2767	257	EDF-6291			2.84E-06	4.55E-06	8.24E-03	5.90E-05	1.12E-02
Degassing Room Piping				1334	124	EDF-6291			1.37E-06	2.19E-06	3.97E-03	2.85E-05	5.40E-03
Primary Piping in Pump Pits				3264	303	EDF-6291			3.34E-06	5.37E-06	9.72E-03	6.96E-05	1.32E-02
Cubical Exhaust Booster Blower Room				1232	114	EDF-6291			1.26E-06	2.03E-06	3.67E-03	2.63E-05	4.99E-03
Primary Heat Exchanger				68167	6333	EDF-6291			6.99E-05	1.12E-04	2.03E-01	1.45E-03	2.76E-01
Reactor Interior Surface				289	27	EDF-6291			2.96E-07	4.75E-07	8.61E-04	6.16E-06	1.17E-03
Total =								1.52E-05	7.91E-05	1.46E-04	2.30E-01	4.19E-03	3.13E-01
Total w/o Reactor =								1.51E-05	7.88E-05	1.46E-04	2.29E-01	4.17E-03	3.12E-01

	I-129 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U-233 (Ci)	U-235 (Ci)	Total (Ci)
Reactor Vessel	6.32E-09		7.79E-07	1.64E-09	2.08E-09	5.66E-08	9.72E-09	1.31E-10		1.30E-05
Nozzle Trench	1.49E-08		1.83E-06	3.86E-09	4.88E-09	1.33E-07	2.29E-08	3.08E-10		3.07E-05
Biological Shield (over cap)	1.07E-08		1.32E-06	2.77E-09	3.51E-09	9.56E-08	1.64E-08	2.21E-10		2.20E-05
Canal	1.40E-08		1.72E-06	3.62E-09	4.58E-09	1.25E-07	2.15E-08	2.89E-10		2.88E-05
Main Room	1.25E-06		1.54E-04	3.25E-07	4.12E-07	1.12E-05	1.93E-06	2.60E-08		2.59E-03
Storage Area TRA-643	4.16E-08		5.13E-06	1.08E-08	1.37E-08	3.72E-07	6.40E-08	8.61E-10		8.58E-05
Bypass valve room	1.12E-08		1.38E-06	2.91E-09	3.69E-09	1.01E-07	1.73E-08	2.32E-10		2.32E-05
Tank room	9.22E-09		1.14E-06	2.39E-09	3.03E-09	8.26E-08	1.42E-08	1.91E-10		1.90E-05
Main room TRA-644	7.34E-08		9.05E-06	1.91E-08	2.41E-08	6.58E-07	1.13E-07	1.52E-09		1.52E-04
Degassing tank	6.46E-09		7.96E-07	1.68E-09	2.12E-09	5.79E-08	9.94E-09	1.34E-10		1.33E-05
Primary pump pits	3.91E-08		4.83E-06	1.02E-08	1.29E-08	3.51E-07	6.02E-08	8.11E-10		8.08E-05
Emergency shutdown pump pits	6.35E-09		7.83E-07	1.65E-09	2.09E-09	5.69E-08	9.77E-09	1.32E-10		1.31E-05
Degassifier pump pits	6.15E-09		7.59E-07	1.60E-09	2.02E-09	5.51E-08	9.47E-09	1.28E-10		1.27E-05
Nozzle Trench pipe		1.22E-05	1.16E-03	1.88E-07	2.92E-07	3.19E-06		2.87E-08	7.67E-10	2.31E-03
Piping in Bypass Demin Tank & Valve Room		2.11E-04	2.01E-02	3.26E-06	5.05E-06	5.52E-05		4.96E-07	1.33E-08	3.99E-02
Degassing Room Piping		1.02E-04	9.70E-03	1.57E-06	2.44E-06	2.66E-05		2.39E-07	6.40E-09	1.92E-02
Primary Piping in Pump Pits		2.49E-04	2.37E-02	3.84E-06	5.96E-06	6.51E-05		5.85E-07	1.57E-08	4.71E-02
Cubical Exhaust Booster Blower Room		9.40E-05	8.96E-03	1.45E-06	2.25E-06	2.46E-05		2.21E-07	5.91E-09	1.78E-02
Primary Heat Exchanger		5.20E-03	4.96E-01	8.02E-05	1.24E-04	1.36E-03		1.22E-05	3.27E-07	9.83E-01
Reactor Interior Surface		2.20E-05	2.10E-03	3.40E-07	5.28E-07	5.77E-06		5.18E-08	1.39E-09	4.17E-03
Total =	1.49E-06	5.89E-03	5.61E-01	9.12E-05	1.41E-04	1.55E-03	2.30E-06	1.39E-05	3.70E-07	1.12E+00
Total w/o Reactor =	1.49E-06	5.87E-03	5.59E-01	9.09E-05	1.41E-04	1.55E-03	2.29E-06	1.38E-05	3.69E-07	1.11E+00

ENGINEERING DESIGN FILE

Source Term, Grade Level to 3' Below Grade

	Floor (ft2)	Wall (ft2)	Ceiling (ft2	Total (ft2)	Total (m2)	Source Document	Survey Results dpm/100cm2	Ag-108m (Ci)	Am241 (Ci)	C-14 (Ci)	Co-60 (Ci)	Cs-137 (Ci)
Reactor Vessel External				109.96	10.22	EDF-6138	10000	2.43E-08		3.09E-08	4.82E-07	4.07E-06
Canal		641.56		641.56	59.60	EDF-6138	10000	1.42E-07		1.80E-07	2.81E-06	2.38E-05
Console Floor TRA-642		1771	9430.085	11201.09	1040.61	EDF-6138	10000	2.48E-06		3.14E-06	4.91E-05	4.15E-04
Basement TRA-644		669.6	1022	1691.60	157.15	EDF-6138	10000	3.74E-07		4.75E-07	7.42E-06	6.27E-05
Degassifier pump pits		203	40	243.00	22.58	EDF-6138	10000	5.37E-08		6.82E-08	1.07E-06	9.00E-06
Emergency shutdown pump pits		78	41.6	119.6	11.11	EDF-6138	10000	2.65E-08		3.36E-08	5.25E-07	4.43E-06
Primary Filter Pit (TRA-704)			113.9	113.90	10.58	EDF-5965	10000		7.74E-09		4.65E-07	4.02E-06
Secondary Filter Pit (TRA-705)			113.9	113.90	10.58	EDF-5965	10000		7.74E-09		4.65E-07	4.02E-06
Primary Pipe				226	21.00	EDF-6291			2.32E-07	3.72E-07	6.73E-04	4.82E-06
Reactor Interior Surface				108	10.03	EDF-6291			1.11E-07	1.78E-07	3.22E-04	2.30E-06
Total =								3.10E-06	3.58E-07	4.48E-06	1.06E-03	5.34E-04
Total w/o Reactor =								3.07E-06	2.47E-07	4.27E-06	7.35E-04	5.28E-04

	Fe-55 (Ci)	I-129 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-241 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U-233 (Ci)	U-235 (Ci)	U-238 (Ci)	Total (Ci)
Reactor Vessel External		2.39E-09		2.95E-07	6.21E-10	7.86E-10		2.14E-08	3.68E-09	4.95E-11			4.61E-06
Canal		1.40E-08		1.72E-06	3.62E-09	4.58E-09		1.25E-07	2.15E-08	2.89E-10			2.69E-05
Console Floor TRA-642		2.44E-07		3.00E-05	6.32E-08	8.00E-08		2.18E-06	3.75E-07	5.05E-09			4.70E-04
Basement TRA-644		3.68E-08		4.54E-06	9.55E-09	1.21E-08		3.30E-07	5.66E-08	7.62E-10			7.09E-05
Degassifier pump pits		5.28E-09		6.51E-07	1.37E-09	1.74E-09		4.73E-08	8.13E-09	1.09E-10			1.02E-05
Emergency shutdown pump pits		2.60E-09		3.21E-07	6.75E-10	8.55E-10		2.33E-08	4.00E-09	5.39E-11			5.02E-06
Primary Filter Pit (TRA-704)					1.93E-09	1.59E-08	2.24E-07	2.79E-07	0.00E+00	6.42E-10	4.38E-11	1.43E-09	4.50E-06
Secondary Filter Pit (TRA-705)					1.93E-09	1.59E-08	2.24E-07	2.79E-07	0.00E+00	6.42E-10	4.38E-11	1.43E-09	4.50E-06
Primary Pipe	9.16E-04		1.72E-05	1.64E-03	2.66E-07	4.13E-07		4.51E-06		4.05E-08	1.08E-09		6.79E-04
Reactor Interior Surface	4.38E-04		8.24E-06	7.85E-04	1.27E-07	1.97E-07		2.16E-06		1.94E-08	5.18E-10		3.24E-04
Total =	1.35E-03	3.05E-07	2.55E-05	2.47E-03	4.76E-07	7.42E-07	4.48E-07	9.95E-06	4.69E-07	6.75E-08	1.69E-09	2.85E-09	1.60E-03
Total w/o Reactor =	9.16E-04	3.02E-07	1.72E-05	1.68E-03	3.48E-07	5.44E-07	4.48E-07	7.78E-06	4.65E-07	4.81E-08	1.17E-09	2.85E-09	1.27E-03

Source Term Grade Level to 10' Below Grade

	Floor (ft²)	Wall (ft²)	Ceiling (ft²)	Total (ft²)	Total (m²)	Source Document	Survey Results dpm/100cm²	Ac227 (Ci)	Ag-108m (Ci)	Ag-110m (Ci)	Am241 (Ci)	Am243 (Ci)	Be10 (Ci)	C-14 (Ci)	Ce-144 (Ci)	Cl-36 (Ci)	Cm243 (Ci)	Cm244 (Ci)	Cm245 (Ci)	Cm246 (Ci)	Cm247 (Ci)	Cm248 (Ci)	Co60 (Ci)	Cs134 (Ci)	Cs-137 (Ci)
Reactor Building (TRA-642)																									
Reactor Vessel External				366	34.00	EDF-6138	10000		8.10E-08					1.03E-07									1.61E-06		1.36E-05
Canal		2138.52		2138.52	198.68	EDF-6138	10000		4.73E-07					6.00E-07									9.38E-06		7.92E-05
Console Floor		5902.5	9430.085	15332.59	1424.44	EDF-6138	10000		3.39E-06					4.30E-06									6.72E-05		5.68E-04
Balcony		3700	3270.093	6970.093	647.54	EDF-6138	10000		1.54E-06					1.96E-06									3.06E-05		2.58E-04
Compressor Building (TRA-643)																									
PCS Pipe Tunnel		1501.5	2916	4417.5	410.40	EDF-6138	10000		9.77E-07					1.24E-06									1.94E-05		1.64E-04
Heat Exchanger Building (TRA-644)																									
Basement		2232	1022	3254	302.31	EDF-6138	10000		7.20E-07					9.13E-07									1.43E-05		1.21E-04
Degassifier pump pit		203	40	243	22.58	EDF-6138	10000		5.37E-08					6.82E-08									1.07E-06		9.00E-06
Emergency shutdown pump pits		260	41.6	301.6	28.02	EDF-6138	10000		6.67E-08					8.47E-08									1.32E-06		1.12E-05
Delay Tank (TRA-706)		176.13	2795.8	2971.93	276.10	EDF-5965	10000		0.00E+00		2.02E-07			0.00E+00									1.21E-05		1.05E-04
Primary Filter Pit (TRA-704)		316.17	113.9	430.07	39.95	EDF-5965	10000		0.00E+00		2.92E-08			0.00E+00									1.76E-06		1.52E-05
Secondary Filter Pit (TRA-705)		316.17	113.9	430.07	39.95	EDF-5965	10000		0.00E+00		2.92E-08			0.00E+00									1.76E-06		1.52E-05
GEEL Tunnel		552	1840	2392.00	222.22	EDF-6138	10000		5.29E-07					6.71E-07									1.05E-05		8.86E-05
Contaminated Piping																									
Warm Waste Feed from ETR-653				52	4.83	EDF-6291					5.33E-08			8.55E-08									1.55E-04		1.11E-06
PCS Pipe Tunnel Pimary Pipe				2475.5	229.98	EDF-6291					2.54E-06			4.07E-06									7.37E-03		5.28E-05
TRA 644 basement Pimary Pipe				8279.9	769.23	EDF-6291					8.49E-06			1.36E-05									2.47E-02		1.77E-04
Reactor Contamination				361.28	33.56	EDF-6291					3.70E-07			5.94E-07									1.08E-03		7.71E-06
Reactor Activation						EDF-6133		8.49E-09	2.03E-03	6.20E-13	1.52E-03	2.32E-05	3.13E-03	1.11E-01	1.90E-11	1.06E-03	4.23E-06	2.69E-03	5.07E-07	5.60E-07	3.95E-12	7.06E-11	1.65E+01	2.47E-05	2.27E-02
Total =								**8.49E-09**	**2.04E-03**	**6.20E-13**	**1.53E-03**	**2.32E-05**	**3.13E-03**	**1.11E-01**	**1.90E-11**	**1.06E-03**	**4.23E-06**	**2.69E-03**	**5.07E-07**	**5.60E-07**	**3.95E-12**	**7.06E-11**	**1.66E+01**	**2.47E-05**	**2.44E-02**
Total w/0 Reactor =								**0.00E+00**	**7.75E-06**	**0.00E+00**	**1.13E-05**	**0.00E+00**	**0.00E+00**	**2.78E-05**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**3.24E-02**	**0.00E+00**	**1.68E-03**

	Eu152 (Ci)	Eu154 (Ci)	Fe55 (Ci)	H3 (Ci)	I129 (Ci)	Mn54 (Ci)	Nb94 (Ci)	Ni59 (Ci)	Ni63 (Ci)	Np237 (Ci)	Pa231 (Ci)	Pb210 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Pu-244 (Ci)	Ra226 (Ci)	Ru106 (Ci)	Sb125 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	Th228 (Ci)	Th229 (Ci)
Reactor Building (TRA-642)																									
Reactor Vessel External					7.96E-09				9.81E-07				2.07E-09	2.62E-09								7.13E-08	1.22E-08		
Canal					4.65E-08				5.73E-06				1.21E-08	1.53E-08								4.17E-07	7.15E-08		
Console Floor					3.33E-07				4.11E-05				8.66E-08	1.10E-07								2.99E-06	5.13E-07		
Balcony					1.52E-07				1.87E-05				3.94E-08	4.98E-08								1.36E-06	2.33E-07		
Compressor Building (TRA-643)																									
PCS Pipe Tunnel					9.61E-08				1.18E-05				2.49E-08	3.16E-08								8.61E-07	1.48E-07		
Heat Exchanger Building (TRA-644)																									
Basement					7.06E-08				8.72E-06				1.84E-08	2.32E-08								6.34E-07	1.09E-07		
Degassifier pump pit					5.28E-09				6.51E-07				1.37E-09	1.74E-09								4.73E-08	8.13E-09		
Emergency shutdown pump pits					6.56E-09				8.09E-07				1.70E-09	2.15E-09								5.87E-08	1.01E-08		
Delay Tank (TRA-706)					0.00E+00				0.00E+00				5.04E-08	4.15E-07		5.84E-06						7.28E-08	0.00E+00		
Primary Filter Pit (TRA-704)					0.00E+00				0.00E+00				7.29E-09	6.00E-08		8.45E-07						1.05E-06	0.00E+00		
Secondary Filter Pit (TRA-705)					0.00E+00				0.00E+00				7.29E-09	6.00E-08		8.45E-07						1.05E-06	0.00E+00		
GEEL Tunnel					5.20E-08				6.41E-06				1.35E-08	1.71E-08								4.66E-07	8.00E-08		
Contaminated Piping																									
Warm Waste Feed from ETR-653			2.11E-04					3.97E-06	3.78E-04				6.12E-08	9.50E-08								1.04E-06			
PCS Pipe Tunnel Pimary Pipe			1.00E-02					1.89E-04	1.80E-02				2.91E-06	4.52E-06								4.94E-05			
TRA 644 basement Pimary Pipe			3.35E-02					6.31E-04	6.02E-02				9.74E-06	1.51E-05								1.65E-04			
Reactor Contamination			1.46E-03					2.76E-05	2.63E-03				4.25E-07	6.60E-07								7.21E-06			
Reactor Activation	1.53E-03	8.77E-03	0.00E+00	2.76E+02	3.56E-08	2.69E-08	4.05E-02	1.11E+00	2.03E+02	1.80E-08	1.24E-08	5.78E-13	7.01E-04	1.52E-04	1.87E-04	1.52E-02	2.39E-06	2.24E-12	9.34E-13	2.63E-09	5.53E-05	7.08E-03	5.32E-05	1.50E-06	1.01E-08
Total =	**1.53E-03**	**8.77E-03**	**4.52E-02**	**2.76E+02**	**8.06E-07**	**2.69E-08**	**4.05E-02**	**1.11E+00**	**2.03E+02**	**1.80E-08**	**1.24E-08**	**5.78E-13**	**7.15E-04**	**1.73E-04**	**1.87E-04**	**1.52E-02**	**2.39E-06**	**2.24E-12**	**9.34E-13**	**2.63E-09**	**5.53E-05**	**7.32E-03**	**5.44E-05**	**1.50E-06**	**1.01E-08**
Total w/0 Reactor =	**0.00E+00**	**0.00E+00**	**4.38E-02**	**0.00E+00**	**7.62E-07**	**0.00E+00**	**0.00E+00**	**8.24E-04**	**7.87E-02**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.30E-05**	**2.05E-05**	**0.00E+00**	**7.53E-06**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**2.32E-04**	**1.17E-06**	**0.00E+00**	**0.00E+00**

	Th230 (Ci)	Th232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)	Zn65 (Ci)	Total (Ci)
Reactor Building (TRA-642)										
Reactor Vessel External				1.65E-10						**1.53E-05**
Canal				9.63E-10						**8.97E-05**
Console Floor				6.91E-09						**6.43E-04**
Balcony				3.14E-09						**2.92E-04**
Compressor Building (TRA-643)										
PCS Pipe Tunnel				1.99E-09						**1.85E-04**
Heat Exchanger Building (TRA-644)										
Basement				1.47E-09						**1.36E-04**
Degassifier pump pit				1.09E-10						**1.02E-05**
Emergency shutdown pump pits				1.36E-10						**1.26E-05**
Delay Tank (TRA-706)				1.68E-08		1.14E-09		3.72E-08		**1.17E-04**
Primary Filter Pit (TRA-704)				2.42E-09		1.65E-10		5.39E-09		**1.70E-05**
Secondary Filter Pit (TRA-705)				2.42E-09		1.65E-10		5.39E-09		**1.70E-05**
GEEL Tunnel				1.08E-09						**1.00E-04**
Contaminated Piping										
Warm Waste Feed from ETR-653				9.33E-09		2.49E-10				**1.56E-04**
PCS Pipe Tunnel Pimary Pipe				4.44E-07		1.19E-08				**7.43E-03**
TRA 644 basement Pimary Pipe				1.48E-06		3.97E-08				**2.49E-02**
Reactor Contamination				6.48E-08		1.73E-09				**1.08E-03**
Reactor Activation	9.83E-11	1.72E-08	1.45E-06	2.86E-06	2.58E-07	2.13E-09	6.06E-09	7.15E-08	1.43E-12	**1.67E+01**
Total =	9.83E-11	1.72E-08	1.45E-06	4.90E-06	2.58E-07	5.72E-08	6.06E-09	1.20E-07	1.43E-12	**1.67E+01**
Total w/0 Reactor =	0.00E+00	0.00E+00	0.00E+00	1.98E-06	0.00E+00	5.33E-08	0.00E+00	4.80E-08	0.00E+00	3.41E-02

Below Grade

	Floor (ft2)	Wall (ft2)	Ceiling (ft2)	Total (ft2)	Total (m2)	Source Document	Survey Results Average dpm/100cm2
Reactor Vessel					245.4	EDF-6138	10000
Canal	972	4002		4974	462.14	EDF-6138	10000
Console Floor	9430	20357	9430	39217	3643.36	EDF-6138	10000
Balcony	3270		3270	6540	607.60	EDF-6138	10000
Emergency Cooling Loop Cubicles	773	4901	773	6446	598.88	EDF-6138	190932
PCS Pipe Tunnel	406	1261	406	2072	192.52	EDF-6138	190932
Hot Waste Pit	300	951	300	1551	144.12	EDF-6138	
P-7 Primary Cubicle	245		245	489	45.45	EDF-6138	10295
J-10/L-10 Primary Cubicle	214		214	429	39.85	EDF-6138	21871
C-7/M-13/N-14 Primary Cubicle	248		248	497	46.15	EDF-6138	821348
C-7/M-13/N-14 Secondary Cubicle	531		531	1063	98.75	EDF-6138	84580
F-10/H-10 Primary Cubicle	270		270	541	50.26	EDF-6138	872933
F-10/H-10 Auxiliary Cubicle	139		139	278	25.80	EDF-6138	144843
F-10/H-10 Secondary Cubicle	212		212	424	39.43	EDF-6138	315366
Helium System Cubicle	445		445	890	82.64	EDF-6138	11919
L-12/M-7 Primary Cubicle	519		519	1037	96.36	EDF-6138	20860
L-12/M-7 Secondary Cubicle	202		202	404	37.55	EDF-6138	126483
C-13/G-16 Primary Cubicle	237		237	474	44.05	EDF-6138	13139
C-13/G-16 Secondary Cubicle	224		224	448	41.66	EDF-6138	12875
Crud Generator Cubicle	51		51	102	9.44	EDF-6138	190932
Subpile Room Entryway	113		113	226	20.98	EDF-6138	10000
AGS Cubicle	70	315	70	455	42.31	EDF-6138	10000
GEEL Pipe Tunnel (TRA-642)	240	480	240	960	89.19	EDF-6138	190932
M-3 Primary Cubicle	161		161	322	29.87	EDF-6138	19224
M-3/P-7 Secondary Cubicle	74		74	147	13.66	EDF-6138	21418
Warm Waste Pit	300	1165	300	1765	163.97	EDF-6138	190932
Sub-Pile Room	296		296	593	55.05	EDF-6138	13163
Rod Access Room	137		137	274	25.46	EDF-6138	10000
Other Basement Areas (TRA-642)	6891		6891	13782	1280.36	EDF-6138	10000
GEEL Tunnel (TRA-643)				4560	423.64	EDF-6138	10000
PCS Pipe Tunnel (TRA-643)	2916	2288	2916	8120	754.37	EDF-6138	10000
Basement (TRA-644)	1022	4484	1022	6508	604.61	EDF-6138	10000
Emergency shutdown pump pits	42	208	42	292	27.13	EDF-6138	10000
Degassifier pump pits	40	203	40	283	26.29	EDF-6138	10000
Delay Tank (TRA-706)		176	2796	2972	276.10	EDF-5965	10000
Primary Filter Pit (TRA-704)		318	114	430	39.95	EDF-5965	10000
Secondary Filter Pit (TRA-705)		318	114	430	39.95	EDF-5965	10000
GEEL Tunnel		552	1840	2392	222.22	EDF-6138	10000
Warm Waste Feed				52	4.83	EDF-6291	
PCS Tunnel Pipe				4951	459.96	EDF-6291	
TRA 644 basement Primary Pipe				12356	1148.10	EDF-6291	
Canal Piping				1030	95.69	EDF-6291	
Reactor Basement Piping				3306	307.14	EDF-6291	
Waste Tank Pits				1470	136.57	EDF-6291	
AGS Cubicle				149	13.84	EDF-6291	
M3/P7 Cubicle				3531	328.04	EDF-6291	
C7/M13/N14 Cubicle				1935	179.77	EDF-6291	
F10/H10 Cubicle				1091	101.36	EDF-6291	
L13/M7				3830	355.82	EDF-6291	
C13/G16				1831	170.11	EDF-6291	
Rod Access Room				288	26.76	EDF-6291	
Subpile Room				1869	173.64	EDF-6291	
GEEL Tunnel & Delay Tanks				13926	1293.77	EDF-6966	150000
Reactor Contamination				1348	125.23	EDF-6291	
Reactor Activation						EDF-6133	
Total							
Total w/o Reactor							

	Ac227 (Ci)	Ag-108m (Ci)	Ag-110m (Ci)	Am241 (Ci)	Am243 (Ci)	Be10 (Ci)	C-14 (Ci)	Ce-144 (Ci)	Cl-36 (Ci)	Cm243 (Ci)	Cm244 (Ci)
Reactor Vessel		5.64E-07					7.41E-07				
Canal		1.10E-06					1.40E-06				
Console Floor		8.87E-06					1.10E-05				
Balcony		1.45E-06					1.84E-06				
Emergency Cooling Loop Cubicles		2.72E-05					3.46E-06				
PCS Pipe Tunnel		8.75E-06					1.11E-05				
Hot Waste Pit		6.56E-06					3.44E-04				
P-7 Primary Cubicle		1.11E-07					1.41E-07				
J-10/L-10 Primary Cubicle		2.06E-07					2.83E-07				
C-7/M-13/N-14 Primary Cubicle		6.83E-06					8.86E-06				
C-7/M-13/N-14 Secondary Cubicle		1.52E-06					1.93E-06				
F-10/H-10 Primary Cubicle		1.04E-05					1.33E-05				
F-10/H-10 Auxiliary Cubicle		8.90E-07					1.13E-06				
F-10/H-10 Secondary Cubicle		2.96E-06					3.76E-06				
Helium System Cubicle		2.35E-07					2.96E-07				
L-12/M-7 Primary Cubicle		4.81E-07					6.10E-07				
L-12/M-7 Secondary Cubicle		1.15E-06					1.46E-06				
C-13/G-16 Primary Cubicle		1.36E-07					1.75E-07				
C-13/G-16 Secondary Cubicle		1.26E-07					1.60E-07				
Crud Generator Cubicle		4.29E-07					5.45E-07				
Subpile Room Entryway		4.99E-08					6.34E-08				
AGS Cubicle		1.01E-07					1.26E-07				
GEEL Pipe Tunnel (TRA-642)		4.06E-06					5.14E-06				
M-3 Primary Cubicle		1.37E-07					1.73E-07				
M-3/P-7 Secondary Cubicle		6.97E-08					8.85E-08				
Warm Waste Pit		7.45E-06					9.46E-06				
Sub-Pile Room		1.73E-07					2.19E-07				
Rod Access Room		6.06E-08					7.69E-08				
Other Basement Areas (TRA-642)		3.05E-06					3.87E-06				
GEEL Tunnel (TRA-643)		1.01E-06					1.26E-06				
PCS Pipe Tunnel (TRA-643)		1.80E-06					2.28E-06				
Basement (TRA-644)		1.44E-06					1.83E-06				
Emergency shutdown pump pits		5.46E-06					8.20E-06				
Degassifier pump pits		6.26E-08					7.94E-08				
Delay Tank (TRA-706)		0.00E+00		2.02E-07			0.00E+00				
Primary Filter Pit (TRA-704)		0.00E+00		2.92E-06			0.00E+00				
Secondary Filter Pit (TRA-705)		0.00E+00		2.92E-06			0.00E+00				
GEEL Tunnel		5.29E-07					8.71E-07				
Warm Waste Feed				5.33E-06			8.56E-08				
PCS Tunnel Pipe				5.07E-06			6.14E-06				
TRA 644 basement Primary Pipe				1.27E-05			2.03E-05				
Canal Piping				1.09E-06			1.89E-06				
Reactor Basement Piping				3.39E-06			6.44E-06				
Waste Tank Pits				1.51E-06			2.42E-06				
AGS Cubicle				1.53E-07			2.45E-07				
M3/P7 Cubicle				3.62E-06			5.81E-06				
C7/M13/N14 Cubicle				1.96E-06			3.18E-08				
F10/H10 Cubicle				1.12E-05			1.79E-06				
L13/M7				3.92E-06			6.30E-06				
C13/G16				1.66E-06			3.01E-06				
Rod Access Room				2.95E-07			4.74E-07				
Subpile Room				1.92E-06			3.07E-06				
GEEL Tunnel & Delay Tanks				1.42E-05							
Reactor Contamination				1.36E-06			2.22E-06				
Reactor Activation	1.01E-06	2.42E-01	7.40E-11	1.82E-01	2.76E-03	3.73E-01	1.33E+01	2.28E-09	1.26E-01	6.04E-04	3.20E-01
Total	**1.01E-06**	**2.42E-01**	**7.40E-11**	**1.82E-01**	**2.76E-03**	**3.73E-01**	**1.33E+01**	**2.28E-09**	**1.26E-01**	**6.04E-04**	**3.20E-01**
Total w/o Reactor	**0.00E+00**	**9.93E-05**	**0.00E+00**	**8.31E-05**	**0.00E+00**	**0.00E+00**	**6.24E-04**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**

	Cm245 (Ci)	Cm246 (Ci)	Cm247 (Ci)	Cm248 (Ci)	Co60 (Ci)	Cs134 (Ci)	Cs-137 (Ci)	Eu152 (Ci)	Eu154 (Ci)	Fe55 (Ci)	H3 (Ci)
Reactor Vessel					1.16E-06		8.79E-05				
Canal					2.18E-05		1.84E-04				
Console Floor					1.72E-04		1.45E-03				
Balcony					2.67E-05		2.42E-04				
Emergency Cooling Loop Cubicles					5.40E-04		4.88E-03				
PCS Pipe Tunnel					1.74E-04		1.47E-03				
Hot Waste Pit					5.36E-03		2.25E-02				
P-7 Primary Cubicle					2.21E-06		1.87E-05				
J-10/L-10 Primary Cubicle					4.11E-06		3.48E-06				
C-7/M-13/N-14 Primary Cubicle					1.35E-04		1.14E-03				
C-7/M-13/N-14 Secondary Cubicle					3.01E-06		2.84E-04				
F-10/H-10 Primary Cubicle					2.07E-04		1.75E-03				
F-10/H-10 Auxiliary Cubicle					1.76E-05		1.49E-04				
F-10/H-10 Secondary Cubicle					5.67E-05		4.98E-04				
Helium System Cubicle					4.85E-06		3.93E-06				
L-12/M-7 Primary Cubicle					9.53E-06		8.06E-06				
L-12/M-7 Secondary Cubicle					2.28E-05		1.92E-04				
C-13/G-16 Primary Cubicle					2.73E-06		2.31E-05				
C-13/G-16 Secondary Cubicle					2.49E-06		2.11E-05				
Crud Generator Cubicle					8.51E-06		7.19E-05				
Subpile Room Entryway					8.90E-07		8.36E-06				
AGS Cubicle					2.00E-06		1.69E-05				
GEEL Pipe Tunnel (TRA-642)					6.04E-05		6.79E-04				
M-3 Primary Cubicle					2.71E-06		2.28E-05				
M-3/P-7 Secondary Cubicle					1.36E-06		1.17E-05				
Warm Waste Pit					1.48E-04		1.25E-03				
Sub-Pile Room					3.42E-06		2.69E-05				
Rod Access Room					1.20E-06		1.02E-05				
Other Basement Areas (TRA-642)					6.04E-05		5.11E-04				
GEEL Tunnel (TRA-643)					2.00E-05		1.69E-04				
PCS Pipe Tunnel (TRA-643)					3.86E-05		3.01E-04				
Basement (TRA-644)					2.86E-05		2.41E-04				
Emergency shutdown pump pits					1.28E-06		1.08E-05				
Degassifier pump pits					1.24E-06		1.06E-05				
Delay Tank (TRA-706)					1.21E-05		1.06E-04				
Primary Filter Pit (TRA-704)					1.78E-06		1.52E-05				
Secondary Filter Pit (TRA-705)					1.78E-06		1.52E-05				
GEEL Tunnel					1.05E-05		6.86E-05				
Warm Waste Feed					1.55E-04		1.11E-05			2.11E-04	
PCS Tunnel Pipe					1.47E-02		1.06E-04			2.01E-02	
TRA 644 basement Primary Pipe					3.68E-02		2.64E-04			5.01E-02	
Canal Piping					3.07E-03		2.20E-05			4.17E-03	
Reactor Basement Piping					9.86E-03		7.05E-05			1.34E-02	
Waste Tank Pits					4.38E-03		3.14E-05			5.98E-03	
AGS Cubicle					4.44E-04		3.16E-06			6.04E-04	
M3/P7 Cubicle					1.06E-02		7.53E-05			1.43E-02	
C7/M13/N14 Cubicle					6.76E-03		4.13E-05			7.84E-03	
F10/H10 Cubicle					3.25E-03		2.33E-05			4.42E-03	
L13/M7					1.14E-02		8.17E-05			1.56E-02	
C13/G16					5.45E-03		3.91E-05			7.42E-03	
Rod Access Room					8.58E-04		6.14E-06			1.17E-03	
Subpile Room					5.57E-03		3.99E-05			7.57E-03	
GEEL Tunnel & Delay Tanks					8.54E-04		7.36E-03				
Reactor Contamination					4.07E-03		2.66E-05			5.48E-03	
Reactor Activation	6.06E-05	6.68E-05	4.71E-10	8.45E-09	1.87E+03	2.95E-03	2.71E+00	1.62E-01	1.06E+00	6.63E-03	3.29E+04
Total	**6.06E-05**	**6.68E-05**	**4.71E-10**	**8.45E-09**	**1.87E+03**	**2.95E-03**	**2.71E+00**	**1.62E-01**	**1.06E+00**	**1.88E-01**	**3.29E+04**
Total w/o Reactor	**0.00E+00**	**0.00E+00**	**0.00E+00**	**0.00E+00**	**1.30E-01**	**0.00E+00**	**4.83E-02**	**0.00E+00**	**0.00E+00**	**1.83E-01**	**0.00E+00**

	I129 (Ci)	Mn54 (Ci)	Nb94 (Ci)	Ni59 (Ci)	Ni63 (Ci)	Np237 (Ci)	Pa231 (Ci)	Pb210 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)
Reactor Vessel	5.74E-08				7.08E-05				1.49E-08	1.89E-08
Canal	1.08E-07				1.33E-05				2.81E-08	3.55E-08
Console Floor	8.53E-07				1.05E-04				2.21E-07	2.80E-07
Balcony	1.42E-07				1.75E-05				3.69E-08	4.67E-08
Emergency Cooling Loop Cubicles	2.68E-06				3.30E-04				6.95E-07	8.80E-07
PCS Pipe Tunnel	8.60E-07				1.06E-04				2.23E-07	2.83E-07
Hot Waste Pit	1.32E-06				3.29E-03				3.43E-06	4.34E-06
P-7 Primary Cubicle	1.10E-08				1.35E-06				2.85E-09	3.60E-09
J-10/L-10 Primary Cubicle	2.04E-08				2.52E-06				5.30E-09	6.70E-09
C-7/M-13/N-14 Primary Cubicle	6.71E-07				8.27E-05				1.74E-07	2.21E-07
C-7/M-13/N-14 Secondary Cubicle	1.49E-07				1.64E-06				3.88E-08	4.90E-08
F-10/H-10 Primary Cubicle	1.03E-08				1.27E-04				2.67E-07	3.37E-07
F-10/H-10 Auxiliary Cubicle	5.75E-08				1.06E-05				2.27E-08	2.87E-08
F-10/H-10 Secondary Cubicle	2.91E-07				3.58E-05				7.56E-08	9.56E-08
Helium System Cubicle	2.31E-08				2.84E-06				5.99E-09	7.58E-09
L-12/M-7 Primary Cubicle	4.73E-08				5.83E-06				1.23E-08	1.56E-08
L-12/M-7 Secondary Cubicle	1.13E-07				1.39E-05				2.93E-08	3.71E-08
C-13/G-16 Primary Cubicle	1.38E-08				1.67E-06				3.52E-09	4.45E-09
C-13/G-16 Secondary Cubicle	1.24E-08				1.52E-06				3.21E-09	4.06E-09
Crud Generator Cubicle	4.22E-08				5.20E-06				1.10E-08	1.39E-08
Subpile Room Entryway	4.91E-09				6.05E-07				1.27E-09	1.61E-09
AGS Cubicle	9.90E-09				1.22E-06				2.57E-09	3.25E-09
GEEL Pipe Tunnel (TRA-642)	3.89E-07				4.91E-05				1.03E-07	1.31E-07
M-3 Primary Cubicle	1.34E-08				1.66E-06				3.49E-09	4.42E-09
M-3/P-7 Secondary Cubicle	6.86E-09				8.45E-07				1.78E-09	2.25E-09
Warm Waste Pit	7.33E-07				9.04E-05				1.90E-07	2.41E-07
Sub-Pile Room	1.70E-08				2.09E-06				4.40E-09	5.57E-09
Rod Access Room	5.96E-09				7.35E-07				1.55E-09	1.96E-09
Other Basement Areas (TRA-642)	3.00E-07				3.69E-05				7.78E-08	9.85E-08
GEEL Tunnel (TRA-643)	9.92E-06				1.22E-06				2.67E-08	3.26E-08
PCS Pipe Tunnel (TRA-643)	1.77E-07				2.16E-05				4.56E-08	5.80E-08
Basement (TRA-644)	1.42E-07				1.74E-05				3.67E-08	4.65E-08
Emergency shutdown pump pits	6.35E-09				7.83E-07				1.65E-09	2.08E-09
Degassifier pump pits	6.15E-09				7.59E-07				1.60E-09	2.02E-09
Delay Tank (TRA-706)	0.00E+00				0.00E+00				5.04E-08	4.15E-07
Primary Filter Pit (TRA-704)	0.00E+00				0.00E+00				7.29E-09	6.00E-08
Secondary Filter Pit (TRA-705)	0.00E+00				0.00E+00				7.29E-09	6.00E-08
GEEL Tunnel	5.20E-08				6.41E-06				1.35E-08	1.71E-08
Warm Waste Feed				3.97E-06	3.78E-04				6.12E-08	9.50E-08
PCS Tunnel Pipe				3.78E-04	3.80E-02				5.63E-06	9.04E-06
TRA 644 basement Primary Pipe				9.42E-04	8.96E-02				1.45E-05	2.26E-05
Canal Piping				7.86E-06	7.49E-03				1.21E-06	1.88E-06
Reactor Basement Piping				2.52E-04	2.40E-02				3.69E-06	6.04E-06
Waste Tank Pits				1.12E-04	1.07E-02				1.73E-06	2.86E-06
AGS Cubicle				1.14E-05	1.08E-03				1.75E-07	2.72E-07
M3/P7 Cubicle				2.89E-04	2.67E-02				4.16E-06	6.45E-06
C7/M13/N14 Cubicle				1.46E-04	1.41E-02				2.26E-06	3.53E-06
F10/H10 Cubicle				8.32E-05	7.93E-03				1.28E-06	1.99E-06
L12/M7				2.92E-04	2.78E-02				4.51E-06	6.99E-06
C13/G16				1.40E-04	1.33E-02				2.15E-06	3.34E-06
Rod Access Room				2.20E-05	2.09E-03				3.39E-07	5.26E-07
Subpile Room				1.43E-04	1.36E-02				2.20E-06	3.41E-06
GEEL Tunnel & Delay Tanks									3.54E-06	2.91E-05
Reactor Contamination				1.03E-04	9.80E-03				1.59E-06	2.46E-06
Reactor Activation	4.24E-06	3.21E-06	4.83E+00	1.32E+02	2.42E+04	2.15E-06	1.48E-06	6.89E-11	8.36E-02	1.82E-02
Total	2.66E-05	3.21E-06	4.83E+00	1.32E+02	2.42E+04	2.15E-06	1.48E-06	6.89E-11	8.37E-02	1.83E-02
Total w/o Reactor	2.23E-05	0.00E+00	0.00E+00	2.87E-03	2.78E-01	0.00E+00	0.00E+00	0.00E+00	8.38E-05	1.06E-04

	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Pu-244 (Ci)	Ra226 (Ci)	Ru106 (Ci)	Sb126 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	Th228 (Ci)	Th229 (Ci)	Th230 (Ci)	Th232 (Ci)
Reactor Vessel								5.15E-07	8.64E-08				
Canal								9.69E-07	1.86E-07				
Console Floor								7.64E-06	1.31E-06				
Balcony								1.27E-06	2.19E-07				
Emergency Cooling Loop Cubicles								2.40E-05	4.12E-06				
PCS Pipe Tunnel								7.71E-06	1.32E-06				
Hot Waste Pit								2.82E-03	2.03E-05				
P-7 Primary Cubicle								9.82E-08	1.69E-08				
J-10/L-10 Primary Cubicle								1.83E-07	3.14E-08				
C-7/M-13/N-14 Primary Cubicle								6.01E-06	1.03E-06				
C-7/M-13/N-14 Secondary Cubicle								1.34E-06	2.30E-07				
F-10/H-10 Primary Cubicle								8.20E-06	1.88E-06				
F-10/H-10 Auxiliary Cubicle								7.64E-07	1.35E-07				
F-10/H-10 Secondary Cubicle								2.61E-06	4.48E-07				
Helium System Cubicle								2.07E-07	3.55E-08				
L-12/M-7 Primary Cubicle								4.23E-07	7.27E-08				
L-12/M-7 Secondary Cubicle								1.01E-06	1.74E-07				
C-13/G-16 Primary Cubicle								1.21E-07	2.06E-08				
C-13/G-16 Secondary Cubicle								1.11E-07	1.90E-08				
Crud Generator Cubicle								3.78E-07	6.49E-08				
Subpile Room Entryway								4.40E-08	7.56E-09				
AGS Cubicle								8.87E-08	1.52E-08				
GEEL Pipe Tunnel (TRA-642)								3.57E-06	6.13E-07				
M-3 Primary Cubicle								1.20E-07	2.07E-08				
M-3/P-7 Secondary Cubicle								6.14E-08	1.05E-08				
Warm Waste Pit								6.56E-06	1.13E-06				
Sub-Pile Room								1.62E-07	2.61E-08				
Rod Access Room								5.34E-08	9.17E-09				
Other Basement Areas (TRA-642)								2.69E-06	4.61E-07				
GEEL Tunnel (TRA-643)								8.88E-07	1.53E-07				
PCS Pipe Tunnel (TRA-643)								1.58E-06	2.72E-07				
Basement (TRA-644)								1.27E-06	2.18E-07				
Emergency shutdown pump pits								5.69E-08	9.77E-09				
Degassifier pump pits								5.51E-08	9.47E-09				
Delay Tank (TRA-706)		5.84E-06						7.28E-06	0.00E+00				
Primary Filter Pit (TRA-704)		8.46E-07						1.05E-06	0.00E+00				
Secondary Filter Pit (TRA-705)		8.45E-07						1.06E-06	0.00E+00				
GEEL Tunnel								4.66E-07	8.00E-08				
Warm Waste Feed								1.04E-06					
PCS Tunnel Pipe								9.88E-06					
TRA 644 basement Primary Pipe								2.47E-04					
Canal Piping								2.06E-05					
Reactor Basement Piping								6.60E-06					
Waste Tank Pits								2.93E-05					
AGS Cubicle								2.97E-06					
M3/P7 Cubicle								7.06E-06					
C7/M13/N14 Cubicle								3.86E-06					
F10/H10 Cubicle								2.16E-05					
L12/M7								7.64E-06					
C13/G16								3.65E-05					
Rod Access Room								5.75E-06					
Subpile Room								3.73E-06					
GEEL Tunnel & Delay Tanks		4.10E-04						6.12E-04					
Reactor Contamination								2.69E-05					
Reactor Activation	2.23E-02	1.82E+00	2.84E-04	2.67E-10	1.11E-10	3.13E-07	6.60E-03	8.45E-01	6.34E-03	1.79E-04	1.20E-06	1.17E-08	2.05E-06
Total	2.23E-02	1.82E+00	2.84E-04	2.67E-10	1.11E-10	3.13E-07	6.60E-03	8.49E-01	6.38E-03	1.79E-04	1.20E-06	1.17E-08	2.05E-06
Total w/o Reactor	0.00E+00	4.18E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.18E-03	3.43E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00

	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)	Zn65 (Ci)	Total (Ci)
Reactor Vessel		1.19E-09						**1.11E-04**
Canal		2.24E-08						**2.88E-04**
Console Floor		1.77E-08						**1.84E-03**
Balcony		2.95E-09						**2.74E-04**
Emergency Cooling Loop Cubicles		5.55E-08						**5.10E-03**
PCS Pipe Tunnel		1.78E-08						**1.88E-03**
Hot Waste Pit		2.73E-07						**2.83E-02**
P-7 Primary Cubicle		2.27E-10						**2.11E-05**
J-10/L-10 Primary Cubicle		4.23E-10						**3.93E-05**
C-7/M-13/N-14 Primary Cubicle		1.39E-08						**1.28E-03**
C-7/M-13/N-14 Secondary Cubicle		3.09E-09						**2.88E-04**
F-10/H-10 Primary Cubicle		2.13E-08						**1.98E-03**
F-10/H-10 Auxiliary Cubicle		1.61E-09						**1.88E-04**
F-10/H-10 Secondary Cubicle		6.03E-09						**5.91E-04**
Helium System Cubicle		4.78E-10						**4.48E-05**
L-12/M-7 Primary Cubicle		9.79E-10						**9.11E-05**
L-12/M-7 Secondary Cubicle		2.34E-09						**2.14E-04**
C-13/G-16 Primary Cubicle		2.81E-10						**2.81E-05**
C-13/G-16 Secondary Cubicle		2.56E-10						**2.38E-05**
Crud Generator Cubicle		8.74E-10						**8.13E-05**
Subpile Room Entryway		1.02E-10						**9.47E-06**
AGS Cubicle		2.05E-10						**1.91E-05**
GEEL Pipe Tunnel (TRA-642)		8.26E-09						**7.88E-04**
M-3 Primary Cubicle		2.78E-10						**2.88E-05**
M-3/P-7 Secondary Cubicle		1.42E-10						**1.32E-05**
Warm Waste Pit		1.52E-08						**1.41E-03**
Sub-Pile Room		3.51E-10						**3.27E-05**
Rod Access Room		1.23E-10						**1.18E-05**
Other Basement Areas (TRA-642)		6.21E-09						**6.79E-04**
GEEL Tunnel (TRA-643)		2.05E-09						**1.91E-04**
PCS Pipe Tunnel (TRA-643)		3.66E-09						**3.41E-04**
Basement (TRA-644)		2.93E-09						**2.73E-04**
Emergency shutdown pump pits		1.32E-10						**1.22E-05**
Degassifier pump pits		1.28E-10						**1.18E-05**
Delay Tank (TRA-706)		1.66E-08		1.14E-09		3.72E-08		**1.17E-04**
Primary Filter Pit (TRA-704)		2.42E-09		1.65E-10		5.39E-09		**1.70E-05**
Secondary Filter Pit (TRA-705)		2.42E-09		1.65E-10		5.39E-09		**1.70E-05**
GEEL Tunnel		1.06E-09						**1.00E-04**
Warm Waste Feed		9.33E-09		2.49E-10				**3.87E-04**
PCS Tunnel Pipe		8.86E-07		2.37E-08				**3.49E-02**
TRA 644 basement Primary Pipe		2.22E-06		5.93E-08				**8.72E-02**
Canal Piping		1.85E-07		4.94E-09				**7.27E-03**
Reactor Basement Piping		5.93E-07		1.59E-08				**2.33E-02**
Waste Tank Pits		2.64E-07		7.08E-09				**1.04E-02**
AGS Cubicle		2.67E-08		7.15E-10				**1.06E-03**
M3/P7 Cubicle		6.33E-07		1.69E-08				**2.49E-02**
C7/M13/N14 Cubicle		3.47E-07		9.26E-09				**1.37E-02**
F10/H10 Cubicle		1.96E-07		5.23E-09				**7.70E-03**
L12/M7		6.87E-07		1.84E-08				**2.70E-02**
C13/G16		3.28E-07		8.78E-09				**1.29E-02**
Rod Access Room		5.16E-08		1.38E-09				**2.03E-03**
Subpile Room		3.35E-07		8.96E-09				**1.32E-02**
GEEL Tunnel & Delay Tanks		1.18E-06				2.82E-06		**8.24E-03**
Reactor Contamination		2.42E-07		6.47E-09				**9.51E-03**
Reactor Activation	1.73E-04	3.41E-04	3.07E-05	2.82E-07	7.23E-07	8.53E-06	1.71E-10	**3.49E+04**
Total	1.73E-04	3.50E-04	3.07E-05	4.51E-07	7.23E-07	1.12E-05	1.71E-10	**3.49E+04**
Total w/o Reactor	0.00E+00	8.42E-06	0.00E+00	1.62E-07	0.00E+00	2.67E-06	0.00E+00	**3.20E-01**