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Naval Reactors Laboratory Field Office
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NRLFO:AMO-S:ESH:12-006
February 1, 2012

Mr. Paul A. Giardina, Chief
Radiation and Indoor Air Branch
Division of Environmental Planning and Protection
U.S. Environmental Protection Agency
Region 2
290 Broadway - 25th Floor
New York, New York 10007-1866

Dear Mr. Giardina:

Subject: **DEPARTMENT OF ENERGY - KNOLLS SITE REVISED REPORT OF RADIONUCLIDE AIR EMISSIONS FOR CALENDAR YEAR 2009**

Enclosed pursuant to 40 CFR 61.94 is the revised Calendar Year 2009 Radionuclide National Emissions Standards for Hazardous Air Pollutants Report for the Department of Energy (DOE) - Knolls Site in Niskayuna, NY.

This report includes all activities at the DOE-Knolls Site for calendar year 2009, including the DOE-Separations Process Research Unit (SPRU) activities. DOE-Kesselring Site information was submitted in Knolls Atomic Power Laboratory original 2009 report and is not resubmitted in this report as it is not part of the DOE - Knolls Site in Niskayuna, NY.

This document reflects resolution of comments from the DOE Office of Health, Safety, and Security.

Should you have any questions or need additional information, please contact me at (518) 395-4443 or D. A. Delwiche of my staff at (518) 395-6366.

Sincerely,

T. E. Ketcham
Assistant Manager for Operations

Enclosure:
As Stated

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U. S. Department of Energy
Radionuclide Air Emissions Annual Report
(under Subpart H of 40 CFR 61)
Calendar Year 2009

Site Name: Department of Energy - Knolls Site

Location: 2401 River Road

Niskayuna, New York 12309

EPA Region II

Operations Office Information:

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Separations Process Research Unit – Disposition Project Site Information

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Section I - Facility Information

Site Description

The Department of Energy (DOE) Knolls Site is located in the Town of Niskayuna, New York, approximately 3.2 kilometers east of the City of Schenectady. The Site is situated on 170 acres of land on the south bank of the Mohawk River. The surrounding area is a mixture of open land, light industry, small farms and suburban residential areas. The annual average temperature is about 8.6°C, and the annual average precipitation is about 98 centimeters per year from the Albany National Weather Service. The prevailing winds are from the west to the northwest with a secondary maximum from the south to the south-southeast. The population residing within 80 kilometers of the Site is about 1.31 million persons based on 2000 census data. The 2000 census data were the most current data at the time DOE prepared the 2009 annual report.

The principal function of the Knolls Atomic Power Laboratory (KAPL) is research and development in the design and operation of naval nuclear propulsion plants. Facilities at the Knolls Site that handle radioactive materials include chemical, metallurgical and radioactive material laboratories, and a radioactive waste management facility.

The Separations Process Research Unit – Land Area (SPRU LA) work area covers 30 acres of which approximately 6.5 acres are estimated to be contaminated chemically and/or radiologically from past operations and require cleanup. The SPRU LA are undergoing remediation of soils contaminated in the 1950s during the development of chemical separation processes for the DOE's predecessor agency, the Atomic Energy Commission.

The Separations Process Research Unit – Disposition Project (SPRU DP) work area covers 3 acres within the 170 acres of land belonging to DOE-Knolls Site on the south bank of the Mohawk River. The SPRU DP is engaged in remediation of buildings and lands contaminated during the 1950's during development of chemical separation processes for the DOE's predecessor agency, the Atomic Energy Commission.

Source Description

Radioactive Materials Used at the Facility - KAPL:

a. Natural, depleted, and enriched uranium (unirradiated) is used in several different facilities including chemical and metallurgical/ceramics development laboratories, and a storage vault.

b. Physical, chemical, and metallurgical testing of small quantities of highly radioactive irradiated fissile and non-fissile specimens is conducted in the shielded hot cells of the Radioactive Materials Laboratory. Physical, chemical, and metallurgical testing is also performed on low activity specimens in gloveboxes. The specimens analyzed may contain natural, depleted, or enriched uranium, fission products (e.g., Cs-137, Sr-90, Kr-85), transuranic radionuclides, and activated corrosion and wear products (e.g., Co-60).

c. Operations in chemistry laboratories include chemical analyses, radiochemistry analyses, and other related analytical and developmental functions. Calibration sources (e.g., Cs-137, Sr-90, Th-230, and mixed gamma standards) are used in the radiochemistry laboratories to calibrate and check alpha/beta and gamma counting systems.

d. The small volumes of water used in radiological facilities are collected and processed with an adsorbent and shipped off site in an adsorbed form to an approved disposal facility. The processed radioactive water may contain low levels of Sr-90, Cs-137, uranium, plutonium, and tritium.

e. Calibration and check sources are used on radiation survey equipment and dosimetry devices.

f. Sealed sources are used in gamma densitometers (Cs-137) and other miscellaneous instruments. Infrequently a radiography source (Ir-192 or Co-60) may be utilized.

Description of the Handling and Processing that Radioactive Materials Undergo at the Facility - KAPL:

Radioactive materials are handled and processed in several types of facilities including a storage vault, hot cells, chemical and metallurgical laboratories, and as part of decontamination operations of facilities and equipment. Physical, chemical, and metallurgical testing of small quantities of highly radioactive material specimens is performed in the Radioactive Materials Laboratory hot cells. Corrosion testing, chemical analyses, radiochemistry, and other related analytical and developmental functions are conducted in chemical laboratories. Similarly, metallurgical laboratories provide support services related to the testing and development, and inspection of various materials, including radioactive material. Radioactive work is performed in appropriate containment; storage and movement of radioactive materials are under strict control.

As a result of the operations conducted at the facility, some radioactive wastes are generated. The volume of solid radioactive waste that requires disposal is minimized through the use of procedures that limit the amount of materials that become contaminated, and through waste reduction and recycling.

Radioactive Materials Used at the Facility – SPRU LA

The principal radiological hazard is soil contamination at the North Field and Lower Level excavation sites. Cs-137 is the primary radionuclide identified in the *Nuclear Facility Historical Site Assessment for the Separations Process Research Unit (SPRU) Disposition Project* (ERG 2006), which was prepared for the DOE's SPRU Project Office by Environmental Resource Group, LLC.

Description of the Handling and Processing that Radioactive Materials Undergo at the Facility – SPRU LA

The nature of the work performed by Accelerated Remediation Company at SPRU during 2009 consisted of the excavation and subsequent packaging for disposal of radioactive contaminated soils from the North Field and Lower Level sites.

Radioactive Materials Used at the Facility – SPRU DP

The principal radiological hazards associated with SPRU DP are contamination within the G2 and H2 Buildings and associated tunnels and contamination within the tank farm vaults and tank farm tanks. The primary radionuclides are Sr-90, Cs-137, Pu-239, and Am-241. Numerous evaluations have demonstrated that these four radionuclides and their decay products (Ba-137m for Cs-137, Y-90 for Sr-90) or parent (Pu-241 for Am-241) constitute at least 99% of the potential calculated radiation dose to offsite receptors.

Also, Cs-137, Sr-90, Pu-239, and Am-241 are the primary radionuclides identified in the *Nuclear Facility Historical Site Assessment for the Separations Process Research Unit (SPRU) Disposition Project*, which was prepared for the DOE's SPRU Project Office by Environmental Resource Group LLC, dated April 2006. The radionuclide characterization is further described in archived facility hazard categorization documents and radiological engineering documents.

Description of the Handling and Processing that Radioactive Materials Undergo at the Facility-SPRU DP:

The nature of the work performed by SPRU DP during 2009 consisted of preparations for demolition of the buildings, operating radioactive water processing systems, maintenance, removal and/remediation of radioactive and hazardous materials, and excavation and packaging of contaminated soil. With the exception of the soil excavation work, the efforts that resulted in reportable emissions were conducted within the H2 and G2 Buildings and the emissions were monitored with weekly air sampling of the buildings' air discharges. Soil emissions were calculated from an EPA approved model and laboratory measurements of radionuclide concentrations in soil. Qualified subcontractors removed asbestos from the interior of both H2 and G2 buildings utilizing appropriate tents and enclosures.

As a result of the operations conducted at the facility, radioactive wastes are generated. The volume of solid radioactive waste that requires disposal is minimized through the use of procedures that limit the amount of materials that become contaminated, and through waste reduction and recycling.

Section II - Air Emission Data

Point Source

KAPL

Radionuclide emissions from monitored emission points were calculated based on sampling system measurement results, radiochemistry results (gross alpha, gross beta, and gamma spectrometry), and stack flow measurements. Kr-85 emissions were based upon integrated data from a noble gas monitoring system. The KAPL point source emission data is shown in Tables 1 and 2.

Table 1 - KAPL Point Source Air Emission Data – 2009

Point Source	Type Control[1]	Efficiency (%)[1]	Distance to Nearest Receptors (meters)[2]			Principal Radionuclides[3]
			Residence	Business	Vegetable Farm	
Building F4	HEPA Filter	99.95	575	450	700	U-234, Sr-90, Cs-137
Building F2	HEPA Filter	99.95	550	450	725	U-234, Sr-90, Cs-137
Building F3 Room 23	HEPA Filter	99.95	550	450	725	U-234, U-238
Building E1	HEPA Filter[4]	99.95	475	600	750	U-234, Sr-90, Cs-137
Building E4	HEPA Filter[5]	99.95	500	525	725	Pu-238, Sr-90, Cs-137
Building E5	HEPA Filter	99.95	500	500	725	Co-60
Building E11	HEPA Filter	99.95	410	575	800	Pu-238, Sr-90, Cs-137
Building G1	HEPA Filter[4]	99.95	400	550	825	U-234, Sr-90, Cs-137
Building H2[6]	HEPA Filter	99.95	550	425	775	Pu-239, Sr-90, Cs-137
Building H2 Stack[6]	None	-	550	425	775	Pu-239, Sr-90, Cs-137
Building H2 Hillside Sump Vent[6]	None	-	550	400	775	Pu-239, Sr-90, Cs-137
Building C6	HEPA Filter	99.95	400	600	800	U-234
Building D3[7]	HEPA Filter[4]	99.95	350	600	875	U-234
Building D4	HEPA Filter[4]	99.95	375	575	850	U-234
Building D4 Room 161	HEPA Filter	99.95	350	600	875	U-234
Building E1/G1 Vents	Static HEPA Filter	99.95	425	550	800	U-234, Sr-90, Cs-137
Building E1/G1 Basement	None	-	400	550	825	U-234, Sr-90, Cs-137
Building G1 Air Sample Pump Exhaust	Note 8	99.95	400	550	825	U-234, Sr-90, Cs-137
Building A3	None	-	300	650	900	U-234

See notes on next page.

Notes for KAPL Point Source Air Emission Data Table 1:

(1) The HEPA filters are tested by the manufacturer to exhibit a minimum collection efficiency of 99.97% for 0.3 micron dioctylphthalate (DOP) or equivalent aerosol particles. Exhaust filters are tested with DOP prior to installation or tested in-place after installation and re-tested in-place on an annual basis, as a minimum, to ensure continued integrity. In-place testing requires a minimum collection efficiency of 99.95% for 0.7 micron DOP smoke aerosol particles. Static HEPA filters are tested only prior to installation and are changed out every six years.
(2) The nearest farm producing meat and/or milk is about 2000 meters, and the nearest school is about 1700 meters. The distances for this table were determined using ArcMap GIS software.
(3) Radionuclides that could contribute more than 10% of the potential effective dose equivalent for the release point.
(4) Air from radiological facilities (hoods and glove box containments) is exhausted through HEPA filters. Exhausts for some room air and air from non-radiological hoods are not HEPA-filtered.
(5) Charcoal adsorbers, which contain triethylene diamine (TEDA) impregnated carbon, are also used and are tested by the manufacturer to ensure a minimum 99.9% mechanical efficiency.
(6) Building H2, Building H2 Stack and Building H2 Hillside Sump were transferred to DOE Office of Environmental Management on April 13, 2009 as part of the Separations Process Research Unit remediation project.
(7) The D3 ventilation system was permanently shut down on October 1, 2009.
(8) The exhaust air passes through two-inch diameter glass fiber filters with typical collection efficiency, as tested by the manufacturer, of 99.98% or greater for 0.3 micron dioctylphthalate (DOP) or equivalent particles.

Table 2 - KAPL Air Emission Data – 2009

Radionuclide	Annual Quantity Ci[(1)]
Kr-85	2.27 E-01
Co-60	9.99 E-09
Sr-90	2.66 E-06
Y-90	2.66 E-06
Cs-137	2.66 E-06
U-234	5.08 E-07
U-235	8.56 E-09
U-236	1.59 E-09
U-238	9.65 E-12
Pu-238	1.69 E-08
Pu-239	4.85 E-08

Note:
(1) 1 Ci = 3.7E-2 TBq

SPRU LA

There were no point sources for SPRU-LA in 2009.

SPRU DP

The point source release data from the H2 stack and G2 vent were obtained from continuous particulate air samples that were collected from the stacks on a weekly basis. The flow rates of the samplers were read from rotameters. The sample pumps were calibrated annually according to SPRU DP procedures. Glass fiber filters (47 mm) were used to capture particulate samples. The building exhaust rates were based on process knowledge of steady state flow rates.

The point source emission data include releases from the H2 stack and G2 vent that occurred in 2009 after the buildings were turned over to the SPRU DP. SPRU DP staff performed daily surveillances and recorded operability status. The exhaust flowrate instrument for G2 was calibrated by the SPRU DP during CY 2009. Process knowledge of the system operating parameters was used to determine the G2 exhaust flow rate for the period when the instrument was out of service. Exhaust flowrates for H2 were recorded following turnover of the building. The H2 stack surveillance records do not indicate any period when the flowrate instrument was out of service. The HEPA filters that were installed at the time of turnover were not replaced or tested in place during CY 2009.

Radiological control technicians operated continuous sampling equipment and collected weekly air particulate samples from the installed sampling points in the ducts. The systems, operating methods, and sampling process were equivalent to the prior methods used before turnover. Air filter samples were analyzed for gross alpha and gross beta radioactivity with a low background gas proportional counter. The weekly air filter samples did not indicate a failure of any HEPA filter during 2009.

Table 3 lists the SPRU DP point source emissions relative to offsite receptors and types of radionuclide measurements.

Table 3 - SPRU DP Point Source Air Emission Data – 2009

Point Source	Type Control[1]	Efficiency (%)[1]	Distances from Point Sources to Nearest Receptors (m)[2]			Radionuclide Measurements
			Residence	Business	Vegetable Farm	
Building G2 Vent	HEPA	99.95	475	475	800	Gross alpha, beta
Building H2 Stack	HEPA	99.95	550	425	775	Gross alpha, beta

Notes for SPRU DP Point Source Air Emission Data Table 3:

1. The HEPA filters are tested by the manufacturer to exhibit a minimum collection efficiency of 99.97% for 0.3 micron dioctylphthalate (DOP) or equivalent aerosol particles. The G2 filters were tested by KAPL in May 2008. The H2 filters were tested by KAPL in August 2008. The HEPA filters that were installed at the time of turnover were not replaced or tested in place during CY 2009.
2. The nearest farm producing meat and/or milk is about 2000 meters, and the nearest school is about 1700 meters away. The nearest receptor is 450 meters from the centrally modeled emission point between SPRU DP and KAPL.

Radionuclides that contribute more than 1% of the effective dose equivalent for the point sources are Cs-137, Sr-90, Pu-239 and Am-241. Isotopic concentrations were scaled from gross alpha/beta data measurements. Cs-137 and Sr-90 are assumed to be in equilibrium with their decay products. Pu-241, which decays to Am-241, is included for completeness because the CAP88 PC code evaluates dose over a period of 100 years. The emissions of radionuclides are provided in Table 4. The radionuclides were included in the CAP88 calculations, based on scaling factors derived from SPRU REC-10-015 Revision 0, *Total SPRU DP Source Term.*

The emission quantities are based on the product of measured concentration and estimated exhaust flow rates for each measurement period. The minimum detectable activity (MDA) was applied in place of the actual concentration whenever the observed concentration was less than the MDA.

The air particulate samples were counted with a low background alpha beta gas proportional counter. The samples were decayed as required to eliminate radon decay products. Radionuclide ratios were determined from laboratory analysis of characterization samples. The radionuclide ratios obtained from characterization samples were applied to the net gross count results to detemine the radionuclide concentrations of the major radionuclides. Table 4 presents the radionuclides released in SPRU DP point sources in 2009.

Table 4 - SPRU DP Point Source Emissions Details – 2009

Radionuclide	G2 Vent, (Ci)	H2 Stack, (Ci)	Annual Quantity, (Ci)
Am-241(1)	4.5E-09	2.9E-08	3.4E-08
Cs-137(2)	5.2E-07	4.0E-06	4.5E-06
Sr-90(2)	9.8E-08	7.4E-07	8.3E-07
Pu-239(1)	2.8E-08	1.8E-07	2.1E-07
Pu-241	1.5E-08	9.8E-08	1.1E-07

Notes for SPRU DP Point Source Emissions Details Table 4:

1. Scaled from gross alpha according to radionuclide ratios reported in SPRU REC-10-015 Revision 0-*Total SPRU DP Source Term*. The average Pu-241 concentration is 54% of the Pu-239 concentration. Note that 1 Ci = 3.7E-2 TBq.
2. Scaled from gross beta according to radionuclide ratios reported in laboratory analyses of characterization samples. Ba-137m and Y-90 are assumed to be present at 100% equilibrium.

Non-Point Source

KAPL

Historical Soil Contamination

Historical soil contamination is a potential diffuse source at the DOE Knolls Site. The principal nuclide associated with the historical contamination is Cs-137. The soil was contaminated over 45 years ago as a result of various waste handling operations. During 2009, the majority of the contaminated soil areas were under the cognizance of SPRU remediation project. The remaining areas with potential soil contamination are either paved over or are covered with vegetation and do not represent a significant source of airborne radionuclides. It is estimated that any dose received by a member of the public would be much less than 1% of the dose received by point sources.

SPRU LA

The generation of airborne radioactive material occurs from the excavation and subsequent packaging for disposal of radioactive contaminated soils. Approximately 7,018 yd^3 (5,366 m^3) of

material from the Lower Level and 1,491 yd^3 (1,140 m^3) from the North Field were excavated, stockpiled, and packaged for disposal during 2009. The volume of contaminated soil excavated and stockpiled in 2009 was determined from the onsite daily excavation logs.

There were no point source emissions, such as stacks or vents, for the operation. Generation and disturbance locations would have been localized at the specific excavation area within the SPRU project site. Figure 1 shows the general location of the remediation work in relation to the Knolls site.

The radionuclides identified in Table 5 were used in calculating offsite doses from the Lower Level and the North Field. The methodology for the source term development consisted of using the onsite high purity germanium (HPGe) soil pile measurements for Pb-212, Pb-214, Tl-208, Bi-212, U-235, U-238, and Cs-137. The concentrations were the average of the nuclide activity for each soil pile if detected, and, if not detected, the minimum detectable activity was used. Soil pile samples were collected from all of the North Field soil piles and all of the soil piles containing soils excavated in the Lower Level in 2009.

Sr-90, U-234, Pu-238, Pu-239, Pu-240, Pu-241, and Am-241 concentrations were not provided by the HPGe analyses. Therefore, the maximum detected value for each radionuclide provided from offsite laboratory soils pile data or the Radiological Completion Interim Reports judgmental or systematic offsite laboratory data were applied to the analysis.

The preferred method for estimating emissions from soil handling is given in the *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities, Final Report* (Eastern Research Group 2004). This reference specifically cites U.S. Environmental Protection Agency (EPA) AP-42 (EPA 1995) as the preferred method. Therefore, this method was used. It is applicable to emissions due to removal or loading of soil for soil moisture in the range 0.25 to 4.8%. The release of contamination can be estimated as:

$$S_s = k(0.0016)(U/2.2)^{+1.3}(M/2)^{-1.4}$$

where:

S_s	=	soil suspension fraction, mCi released/Ci handled
0.0016	=	empirical coefficient
k	=	particle size factor, dimensionless
U	=	mean wind speed, m/s
M	=	material moisture content (%).

Note that units have been converted for radionuclide emissions, while the units in AP-42 are for total suspended material released. Also note that contamination released is in units of mCi,

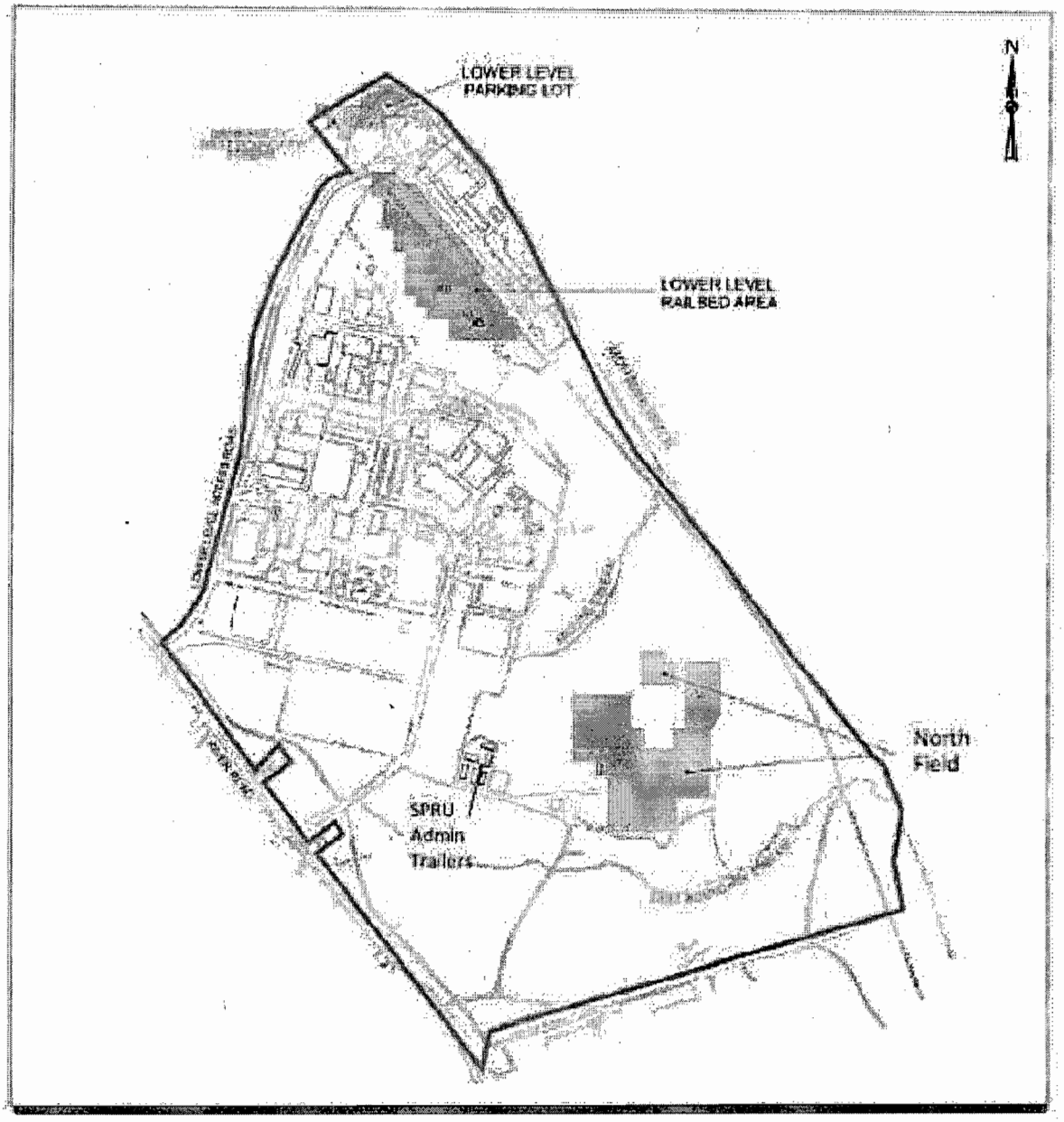

Figure 1 – SPRU LA Lower Level and North Field Excavation Areas

which must be divided by 1,000 for conversion to units of Ci for input into CAP88. If the value of k for 30 µm particles, 0.74, is selected, the numerical parameter is:

$$k(0.0016) = (0.74)(0.0016) = 1.18E-03$$

and the equation becomes:

$$S_s = (1.18E-03)(U/2.2)^{+1.3}(M/2)^{-1.4}$$

where:

S_s = contamination released, mCi released/Ci handled.

The average meteorology for the year 2009 at the Knolls Site indicates that the average wind speed is 2.203 m/s (see CAP88 Weather Data output in Appendix B). Therefore, U = 2.203 m/s is applied for calculating emissions from excavation.

Data for the average soil moisture content were not available for SPRU LA. However, a series of 12 soil samples was analyzed in 2010 for the SPRU DP excavation project, and the average soil moisture reported in GEL Analysis Report 257868 was 11.2%. This result is higher than the range of validity of the method in AP-42. Because the soil moisture value is in the denominator of the equation, the activity release factor decreases as soil moisture increases. Therefore, using a moisture content of 4.8% is conservative, and the equation becomes:

$$S_s = (1.18E-03)(2.203/2.2)^{+1.3}(4.8/2)^{-1.4}$$

$$S_s = 3.48E-04$$

and the release of contamination can be modeled as

$$E_{d,s} = (S_s)(I)(M) = (3.48E-04)(I_d)$$

where:

$E_{d,s}$ = activity of radionuclide "d" released by soil excavation in units of mCi

(I_d) = number of curies of radionuclide "d" handled.

The radionuclide soil activity and release rates from the Lower Level and North Field are provided in Table 5.

Table 5 - SPRU LA Radionuclide Soil Activity and Release Rates 2009

Radionuclide	Lower Level Soil Activity (pCi/g)	Lower Level Release Rate (Ci/yr)	North Field Soil Activity (pCi/g)	North Field Release Rate (Ci/yr)
Am-241	0.16	5.31E-10	0.17	1.21E-10
Bi-212	0.57	1.92E-09	0.00	0.00E+00
Cs-137	7.03	2.36E-08	0.11	7.79E-11
Pb-212	0.60	2.00E-09	0.56	4.00E-10
Pb-214	0.59	1.99E-09	0.54	3.87E-10
Pu-238	0.11	3.73E-10	0.17	1.23E-10
Pu-239	0.63	2.12E-09	2.88	2.06E-09
Pu-240	0.63	2.12E-09	2.88	2.06E-09
Pu-241	2.60	8.74E-09	2.50	1.79E-09
Sr-90	1.47	4.94E-09	0.85	6.07E-10
Tl-208	0.24	8.16E-10	0.20	1.44E-10
U-234	2.09	7.03E-09	2.29	1.64E-09
U-235	0.16	5.35E-10	0.11	8.02E-11
U-238	0.36	1.22E-09	0.25	1.82E-10

Note that 1 Ci = 3.7E-2 TBq.

SPRU LA Summary of Emissions

All diffuse (non-point) emission quantities were determined using process knowledge and EPA AP-42 (EPA 1995). The Ba-137m and Y-90 decay products of Cs-137 and Sr-90 were assumed to be present in full equilibrium. There were no construction or facility modification activities that affected the generation or control of emissions from the project site.

Dust-suppression techniques were employed to reduce dust levels and subsequent emissions from the site. Water sprays and pile coverings were the principal dust-suppression controls used. Sustained (greater than 15 minutes) dust levels were maintained such that dust levels were controlled to less than 150 $\mu g/m^3$ greater than non-excavation ambient dust levels.

SPRU DP

The diffuse releases from SPRU DP include releases from soils removed above the H2 tank vaults. The diffuse emissions were calculated according to the available radionuclide characterization from soil boring data and estimates of soil volume/mass removed to access the tank vaults.

The preferred method for estimating emissions from soil handling is given in *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities, Final Report*, prepared for: USEPA; prepared by: Eastern Research Group, Inc., September 3, 2004. This reference specifically cites US EPA, AP-42, as the preferred method. (US EPA, AP-42, Fifth Edition, Volume 1, Chapter 13: Miscellaneous Sources, Section 13.2.4.3). Therefore, this method was used. It is applicable to emissions due to removal or loading of soil for soil moisture in the range 0.25 to 4.8%. The release of contamination can be estimated as

$$S_s = k(0.0016)(U/2.2)^{+1.3}(M/2)^{-1.4}$$

Where: S_s = Soil suspension fraction, mCi released/Ci handled
0.0016 = Empirical coefficient
k = Particle size factor, dimensionless
U = Mean wind speed, m/s
M = Material moisture content (%)

Note that units have been converted for radionuclide emissions, while the units in AP-42 are for Total Suspended Material released. There is a typographical error in equation 4.1 in the *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities, Final Report*, prepared for USEPA by Eastern Research Group, Inc. September 3, 2004, which printed the value as 0.016. The correct value according to AP-42 is 0.0016 as given above. Also note that contamination released is in units of mCi, which must be divided by 1000 for conversion to units of Ci for input into CAP88. If the value of k for 30 μm particles, 0.74, is selected, the numerical parameter is

$$k(0.0016) = (0.74)(0.0016) = 1.18E\text{-}03$$

and the equation becomes

$$S_s = (1.18E\text{-}03)(U/2.2)^{+1.3}(M/2)^{-1.4}$$

Where: S_s = Contamination released, mCi released/Ci handled

The average meteorology for the year 2009 at the Knolls Site (Appendix C, Attachment E) indicates that the average wind speed was 2.203 m/s. Therefore U = 2.203 m/s is applied for calculating emissions from excavation.

A series of 12 soil samples were analyzed in 2010 and the average soil moisture reported in GEL Analysis Report 257868 was 11.2%. This result is higher than the range of validity of the method in AP-42. Since the soil moisture value is in the denominator of the equation, the activity release factor decreases as soil moisture increases. Therefore using a moisture content of 4.8% is conservative and the equation becomes

$$S_s = (1.18E\text{-}03)(2.203/2.2)^{+1.3}(4.8/2)^{-1.4}$$
$$S_s = 3.48E-04$$

And the release of contamination can be modeled as

$E_{d,s} = (S_s)(I)(M) = (3.48E\text{-}04)(I_d)$

Where $E_{d,s}$ is the activity of radionuclide "d" released by soil excavation in units of mCi and (I_d) is the number of curies of radionuclide "d" handled.

The calculated emissions of radionuclides are provided in Table 6.

Table 6 - SPRU DP Diffuse Emissions – 2009

Radionuclide	Annual Quantity (Ci)
Am-241	3.4E-12
Cs-137	2.1E-09
Sr-90	4.3E-09
Pu-239	2.7E-11
Pu-241	1.5E-11

Note that 1 Ci = 3.7E-2 TBq.

Cs-137 and Sr-90 are assumed to be in equilibrium with their decay products. Pu-241, which decays to Am-241, is included for completeness because the CAP88 PC code evaluates dose over a period of 100 years. The average Pu-241 concentration is 54% of the Pu-239 concentration. The concentration of radionuclides measured in a characterization study was used to determine the quantity of radioactivity in the soil for Cs-137, Pu-239 and Sr-90. Because the characterization analyses did not detect Am-241 in the soil samples, Am-241 was calculated based on the ratio to Pu-239 reported in SPRU REC-10-015 Revision 0-*Total SPRU DP Source Term*.

Waste Shipping

In 2009, movement and storage of waste containers occurred at the SPRU DP outside of the building ventilation systems. The containers were sealed and, therefore, did not represent a potential source of airborne emissions and, as a result, no source term is provided.

SPRU DP Summary of Emissions

The emissions associated with point sources are based on weekly measurements of air particulate concentrations in stack effluents. The exhaust flow rates are based on recorded values. In assessing the data, the MDA was applied in place of the observed concentration whenever the observed concentration was less than the MDA. For ventilation flow rate, the average flow rate of a period (*i.e.,* a week) was used for the week and maximum recorded flow rate for the emission year was used for any period in which stack flow rate was not recorded, for the period of time when the stack was know to be operational. In this respect, the point source emissions data are biased conservatively.

The diffuse emission from soil excavation was calculated based on 483,320 kg of disposed soil that was removed above the H2 vaults. The diffuse release was calculated using methods in *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE*

Facilities, Final Report, prepared for: USEPA; prepared by: Eastern Research Group, Inc., September 3, 2004. This reference specifically cites US EPA, AP-42, as the preferred method. (US EPA, AP-42, Fifth Edition, Volume 1, Chapter 13: Miscellaneous Sources, Section 13.2.4.3). The Cs-137 concentration was 1.23E+01 pCi/g. The Sr-90 concentration was 2.58E+01 pCi/g. The Pu-239 concentration was 1.62E-01 pCi/g. The Am-241 concentration was 2.01E-02 pCi/g. The diffuse release was calculated using methods in USEPA, AP-42, Fifth Edition, Volume 1, Chapter 13: Miscellaneous Sources, Section 13.2.4.2.

Section III - Dose Assessment

Description of Dose Model

The dose model used by KAPL was CAP88-PC Version 2.0. The dose model used by SPRU LA, and SPRU DP was CAP88-PC Version 3.0.

Summary of Input Parameters

Receptor Identification and Location (KAPL, SPRU LA, and SPRU DP)

All point source releases from both KAPL and SPRU DP were considered as originating from a single stack, central to the main emission points between both KAPL and SPRU DP. Diffuse source releases from SPRU LA, and SPRU DP were considered as originating from an area, one meter in height, central to the main emission points between both KAPL and SPRU DP. The distance and direction to the receptor for the maximum potential dose, which is a residence, is approximately 450 meters in the southwest sector. The location was verified by inspecting the CAP88-PC results and comparing doses at the nearest occupied location in each sector. In sectors where a business location is closer than the nearest residence, both the nearest business location and the nearest residence were evaluated. For business locations, an occupancy factor of 8 hours per day was utilized when evaluating doses.

Values Used for all Other User-Supplied Input Parameters for the Computer Models and the Source of These Data:

Common Input Data

a. Wind frequency data and average temperature of 9.1°C were reduced from calendar year 2009 on-site meteorological measurements of wind speed, wind direction and standard deviation of horizontal wind direction, and temperature. The calendar year 2009 annual rainfall of 97.0 centimeters was reduced from on-site meteorological measurements. Data reduction was performed in accordance with EPA-454/R-99-005, "Meteorological Monitoring Guidance for Regulatory Modeling Applications".

b. The average depth of mixing layer, LID = 1000 meters, is the average of the annual mean morning and afternoon mixing depths from George C. Holzworth, "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Through the Contiguous United States," U.S. Environmental Protection Agency Office of Air Programs report, 1972.

c. The distances from the centrally located emission point to the nearest receptors were determined by KAPL with the use of ArcMap Geographical Information System (GIS) software.

d. The food sources fractions used in the assessment were those listed for rural sites in the CAP88-PC program when the Rural EPA Food Source Scenario option was selected. In addition, the agricultural data (livestock densities and cultivated land fractions) were default data as specified within the CAP88-PC program when New York State was selected for the site location.

KAPL Specific Input Data

a. A stack or source height of 1 meter was used to model a ground level release but maintain stack or source height greater than zero per *A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides,* ORNL-5532 (AIRDOS-EPA), (Moore et al. 1979).

b. The total radionuclide emissions from point sources were those from the Table 2 KAPL Air Emission Data – 2009, above. Radionuclide emissions with the exception of Kr-85 were calculated based on sampling system measurement results and radiochemistry results. Kr-85 emissions were based upon integrated data from a noble gas monitoring system.

SPRU LA Specific Input Data

a. The sources were considered to be area sources of approximately 4 acres (16,187 m^2) for the Lower Level and 1 acre (4,047 m^2) for the North Field. Radionuclide release rates were provided in Table 5 above.

b. Source height (PH = 1 m) used to treat as a ground level release but maintain a height greater than zero was per *A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides*, ORNL-5532 (AIRDOS-EPA), (Moore et al. 1979).

SPRU DP Specific Input Data

a. Stack heights, diameters and diffuse source area dimensions are taken or calculated from engineering or historical documents and are provided in Appendix C, Attachments A, and C. Plume rise for point sources was modeled as momentum plume rise with known nominal velocity for H2 and zero velocity for G2. Diffuse (area) sources are modeled as ground-level releases of one meter height and no velocity. Stack height, diameter and release areas were obtained from engineering documents.

KAPL Compliance Assessment - 2009

Effective Dose Equivalent	Location of Maximally Exposed Off-Site Individual (MEOSI)
5.4E-04 mrem (5.4E-03 µSv)*	A residence at about 450 meters in the southwest sector

** 1 mrem = 10 µSv*

The KAPL CAP88-PC calculation output is contained in Appendix A.

Table 7 - Summary of KAPL Dose Equivalents for Calendar Year 2009

Sector	Distance to Nearest Receptor (meters)	Point Source Dose Equivalent (mrem/year)	Notes
N	1000	1.3E-04	
NNW	1300	1.4E-04	
NNW	550	(2.1E-04)	Business*
NW	2550	2.6E-05	
NW	700	(5.7E-05)	Business*
WNW	1050	4.8E-05	
WNW	775	(2.6E-05)	Business*
W	700	8.0E-05	
WSW	750	8.5E-05	
SW	**450**	**5.4E-04**	**MEOSI**
SSW	450	4.6E-04	
S	550	2.4E-04	
SSE	1650	4.5E-05	
SE	1650	7.8E-05	
ESE	1000	1.6E-04	
E	700	2.4E-04	
ENE	700	1.5E-04	
NE	700	1.2E-04	
NNE	950	6.8E-05	

* A correction factor of one-third (8 hours/day) has been applied to the CAP88-PC doses for the nearest receptors at business locations. The adjusted doses are enclosed in parentheses.

SPRU LA Compliance Assessment - 2009

Effective Dose Equivalent	Location of Maximally Exposed Off-Site Individual (MEOSI)
9.7E-06 mrem (9.7E-05 µSv)*	A residence at about 450 meters in the southwest sector

** 1 mrem = 10 µSv*

The SPRU LA CAP88-PC calculation output is provided in Appendix B.

Table 8 - Summary of SPRU LA Dose Equivalents for Calendar Year 2009

Sector	Distance to Nearest Receptor (meters)**	Diffuse Source Dose Equivalent (mrem/year)	Notes
N	1000	2.2E-06	
NNW	1300	2.4E-06	
NNW	550	(3.7E-06)	Business*
NW	2550	4.4E-07	
NW	700	(1.0E-06)	Business*
WNW	1050	8.1E-07	
WNW	775	(4.3E-07)	Business*
W	700	1.4E-06	
WSW	750	1.5E-06	
SW	**450**	**9.7E-06**	**MEOSI**
SSW	450	8.2E-06	
S	550	4.3E-06	
SSE	1650	7.8E-07	
SE	1650	1.4E-06	
ESE	1000	2.7E-06	
E	700	4.2E-06	
ENE	700	2.6E-06	
NE	700	2.2E-06	
NNE	950	1.2E-06	

* A correction factor of one-third (8 hours/day) has been applied to the CAP88-PC doses for the nearest receptors at business locations. The adjusted doses are enclosed in parentheses.

** The nearest farm producing meat and/or milk is approximately 2,000 m central to the main emission points between both KAPL and SPRU-DP, and the nearest school is approximately 1,700 m away. All distances to receptors are measured central to the main emission points between both KAPL and the SPRU DP site. The location of the nearest receptor may or may not correspond to the location of the maximally exposed offsite individual (MEOSI), depending on dispersion and occupancy factors.

SPRU DP Compliance Assessment - 2009

Effective Dose Equivalent	Location of Maximally Exposed Individual
5.4E-05 mrem (5.4E-04 µSv)*	A residence at about 450 meters in the southwest sector

** 1 mrem = 10 µSv*

The SPRU DP CAP88-PC calculation output is provided in Appendix C.

Table 9 - Summary of SPRU DP Dose Equivalents for Calendar Year 2009

Sector	Distance to Nearest Receptor (meters)	Point Source Dose Equivalent (mrem)	Diffuse Source Dose Equivalent (mrem)	Total Dose Equivalent (mrem)	Note
N	1000	3.4E-05	6.9E-10	3.4E-05	
NNW	1300	4.9E-05	7.4E-10	4.9E-05	
NNW	550	(2.6E-05)	(1.3E-09)	(2.6E-05)	Business*
NW	2550	1.4E-05	8.5E-11	1.4E-05	
NW	700	(9.3E-06)	(3.2E-10)	(9.3E-06)	Business*
WNW	1050	1.6E-05	2.1E-10	1.6E-05	
WNW	775	(6.3E-06)	(1.3E-10)	(6.3E-06)	Business*
W	700	1.9E-05	4.0E-10	1.9E-05	
WSW	750	2.1E-05	4.4E-10	2.1E-05	
SW	**450**	**5.4E-05**	**3.2E-09**	**5.4E-05**	**MEOSI**
SSW	450	2.7E-05	2.7E-09	2.7E-05	
S	550	2.0E-05	1.4E-09	2.0E-05	
SSE	1650	1.8E-05	2.0E-10	1.8E-05	
SE	1650	3.1E-05	4.0E-10	3.1E-05	
ESE	1000	5.1E-05	8.5E-10	5.1E-05	
E	700	5.0E-05	1.4E-09	5.0E-05	
ENE	700	2.0E-05	8.2E-10	2.0E-05	
NE	700	1.8E-05	6.7E-10	1.8E-05	
NNE	950	1.7E-05	3.4E-10	1.7E-05	

* A correction factor of one-third (8 hours/day) has been applied to the CAP88-PC doses for the nearest receptors at business locations. The adjusted doses are enclosed in parentheses.

DOE Knolls Site Combined Compliance Assessment - 2009

Effective Dose Equivalent	Location of Maximally Exposed Individual
6.04E-04 mrem (6.04E-03 µSv)*	A residence at about 450 meters in the southwest sector

* 1 mrem = 10 µSv

Table 10 – Summary of DOE Knolls Site Dose Equivalents for Calendar Year 2009

Sector	Distance to Nearest Receptor (meters)	KAPL Total Dose Equivalent (mrem)	SPRU LA Total Dose Equivalent (mrem)	SPRU DP Total Dose Equivalent (mrem)	Knolls Site Total Dose Equivalent (mrem)	Note
N	1000	1.3E-04	2.2E-06	3.4E-05	1.66E-04	
NNW	1300	1.4E-04	2.4E-06	4.9E-05	1.91E-04	
NNW	550	(2.1E-04)	(3.7E-06)	(2.6E-05)	(2.43E-04)	Business*
NW	2550	2.6E-05	4.4E-07	1.4E-05	4.04E-05	
NW	700	(5.7E-05)	(1.0E-06)	(9.3E-06)	(6.70E-05)	Business*
WNW	1050	4.8E-05	8.1E-07	1.6E-05	6.48E-05	
WNW	775	(2.6E-05)	(4.3E-07)	(6.3E-06)	(3.24E-05)	Business*
W	700	8.0E-05	1.4E-06	1.9E-05	1.00E-04	
WSW	750	8.5E-05	1.5E-06	2.1E-05	1.08E-04	
SW	**450**	**5.4E-04**	**9.7E-06**	**5.4E-05**	**6.04E-04**	**MEOSI**
SSW	450	4.6E-04	8.2E-06	2.7E-05	4.95E-04	
S	550	2.4E-04	4.3E-06	2.0E-05	2.64E-04	
SSE	1650	4.5E-05	7.8E-07	1.8E-05	6.38E-05	
SE	1650	7.8E-05	1.4E-06	3.1E-05	1.10E-04	
ESE	1000	1.6E-04	2.7E-06	5.1E-05	2.14E-04	
E	700	2.4E-04	4.2E-06	5.0E-05	2.94E-04	
ENE	700	1.5E-04	2.6E-06	2.0E-05	1.73E-04	
NE	700	1.2E-04	2.2E-06	1.8E-05	1.40E-04	
NNE	950	6.8E-05	1.2E-06	1.7E-05	8.62E-05	

* A correction factor of one-third (8 hours/day) has been applied to the CAP88-PC doses for the nearest receptors at business locations. The adjusted doses are enclosed in parentheses.

Section IV - Additional Information

In accordance with 40 CFR 61.94(b)(8), DOE sites are required to report on all construction and modifications which were completed in CY 2009 but for which the requirement to apply for approval to construct or modify was waived under 40 CFR 61.96.

KAPL

During 2009, there were no new construction projects or modifications to existing operations for which approval to construct or modify was waived under 40 CFR 61.96.

SPRU LA

No construction or facility modification activities affected the generation or control of emissions from the project site during 2009.

SPRU DP

Activities were performed in G2 and H2 in preparation for full-scale dismantlement and demolition. These activities included asbestos abatement, which was performed in appropriate tents and enclosures. Because the asbestos abatement activities were exempt under 40 CFR 61.96, as the maximum abated dose for the asbestos abatement activities was <0.1 mrem, SPRU DP did not submit a request for approval to EPA. Soil excavated above the H2 vaults to allow access for cleanup was also exempt from EPA approval under 40 CFR 61.96 as the activities had a maximum abated dose of <0.1 mrem.

Unplanned Releases

KAPL

There were no unplanned releases to the atmosphere.

SPRU LA

There were no unplanned releases to the atmosphere.

SPRU DP

There were no unplanned releases to the atmosphere.

References

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants (NESHAPs)," *Code of Federal Regulations*, Office of the Federal Register.

Eastern Research Group, Inc., 2004, *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities, Final Report,* prepared for the U.S. Environmental Protection Agency, September 3, 2004.

EPA, 1995, *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources*, Chapter 13: Miscellaneous Sources, Section 13.2.4.3, AP-42, 5th Edition, Office of Air Quality Planning and Standards, Office of Air and Radiation, U.S. Environmental Protection Agency, January 1995.

EPA-454/R-99-005, "Meteorological Monitoring Guidance for Regulatory Modeling Applications," U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, February 2000.

ERG, 2006, *Nuclear Facility Historical Site Assessment for the Separations Process Research Unit (SPRU) Disposition Project,* Environmental Resources Group, LLC, April 2006.

Holzworth, George C., 1972, *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution through the Contiguous United States*, U.S. Environmental Protection Agency Office of Air Programs, January 1972.

Moore, R. E., C. F. Baes III, L. M. McDowell-Boyer, A. P. Watson, F. O. Hoffman, J. C. Pleasant, and C. W. Miller, 1979, *A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides*, ORNL-5532 (AIRDOS-EPA), June 1979.

Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted herein and based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment. See, 18 U.S.C. 1001.

Signature: _____ Date: 2/2/12

T. E. Ketcham,
Assistant Manager for Operations
Naval Reactors Laboratory Field Office - Schenectady

Signature: _____ Date: 1/31/12

F. Marcinowski
Deputy Assistant Secretary for Technical & Regulatory Support
DOE Office of Environmental Management

APPENDIX A

Knolls Atomic Power Laboratory

(KAPL)

CAP88-PC OUTPUT

KAPL

CAP-88PC Calculation Output

2009 Annual Release

Distance to Maximally Exposed Individual: 450 meters in the southwest sector

CAP-88PC Calculated Dose Equivalent: 5.4E-04 mrem/yr

Brief Summary of how the location of the maximally exposed individual is determined:

The distance to the closest residence and/or business in each of the 16 sectors surrounding the Site was determined using the Arcview GIS software. The CAP-88PC code calculates the dose equivalent at each distance entered and in each of the 16 sectors whether or not an actual residence/business is located there and the highest dose calculated is shown on the first page of the CAP-88PC output. Therefore, for each sector the dose equivalent at the closest residence/business was checked to determine which sector location and distance results in the highest potential dose equivalent to a resident. These locations are underlined on page 6 of the "Dose and Risk Equivalent Summaries" report included in the CAP-88PC output. For business locations, an occupancy factor of 8 hours per day was utilized when evaluating doses.

The distance and direction to the maximally exposed individual is approximately 450 meters in the southwest sector.

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Version 2.00

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Mar 26, 2010 10:41 am

Facility: KAPL - KNOLLS SITE
Address: 2401 RIVER ROAD
City: NISKAYUNA
State: NY Zip: 12309

Source Category: ANNUAL EMISSIONS - DOE FACILITY
Source Type: Stack
Emission Year: 2009

Comments: KNOLLS 2009 ANNUAL EMISSIONS EVALUATION
MAXIMALLY EXPOSED INDIVIDUAL

Effective Dose Equivalent (mrem/year)
9.40E-04

See Page 6 of the "Dose and Risk Equivalent Summaries" output.

The maximally exposed member of the public is located in a residence at a distance of 450 meters in the southwest sector.

The calculated effective dose equivalent is 5.4E-04 mrem/year.

At This Location: 450 Meters North Northwest

Dataset Name: KNOLMEI09
Dataset Date: Mar 3, 2010 02:53 pm
Wind File: C:\CAP88PC2\WNDFILES\KAPL2009.WND

MAXIMALLY EXPOSED INDIVIDUAL
(RN-222 Working Level Calculations Excluded)

Location Of The Individual: 450 Meters North Northwest
Lifetime Fatal Cancer Risk: 1.39E-08

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Dose Equivalent (mrem/y)
GONADS	1.87E-04
BREAST	1.67E-04
R MAR	5.96E-04
LUNGS	5.48E-03
THYROID	1.73E-04
ENDOST	2.19E-03
RMNDR	2.28E-04
EFFEC	9.40E-04

RADIONUCLIDE EMISSIONS DURING THE YEAR 2009

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
KR-85	*	0.00	2.3E-01	2.3E-01
SR-90	D	1.00	2.7E-06	2.7E-06
Y-90	Y	1.00	2.7E-06	2.7E-06
CS-137	D	1.00	2.7E-06	2.7E-06
BA-137M	D	1.00	2.7E-06	2.7E-06
U-238	Y	1.00	9.6E-12	9.6E-12
TH-234	Y	1.00	9.6E-12	9.6E-12
PA-234M	Y	1.00	9.6E-12	9.6E-12
U-234	Y	1.00	5.1E-07	5.1E-07
TH-230	Y	1.00	0.0E+00	0.0E+00
RA-226	W	1.00	0.0E+00	0.0E+00
RN-222	*	0.00	0.0E+00	0.0E+00
PO-218	W	1.00	0.0E+00	0.0E+00
PB-214	D	1.00	0.0E+00	0.0E+00
BI-214	W	1.00	0.0E+00	0.0E+00
PO-214	W	1.00	0.0E+00	0.0E+00
PB-210	D	1.00	0.0E+00	0.0E+00
BI-210	W	1.00	0.0E+00	0.0E+00
PO-210	W	1.00	0.0E+00	0.0E+00
U-235	Y	1.00	8.6E-09	8.6E-09
U-236	Y	1.00	1.6E-09	1.6E-09
PU-238	Y	1.00	1.7E-08	1.7E-08
PU-239	Y	1.00	4.9E-09	4.9E-09
CO-60	Y	1.00	1.0E-08	1.0E-08

SITE INFORMATION

Temperature:	9 degrees C
Precipitation:	97 cm/y
Mixing Height:	1000 m

SOURCE INFORMATION

Source Number: 1

Stack Height (m): 1.
Diameter (m): 0.

Plume Rise Momentum (m/s): 0.
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.399	0.442
Fraction From Assessment Area:	0.300	0.601	0.558
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

450 550 700 750 775 950 1000 1050 1300 1650
2550 80000

C A P 8 8 - P C

Version 2.00

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Individual Assessment
Mar 26, 2010 10:41 am

Facility: KAPL - KNOLLS SITE
Address: 2401 RIVER ROAD
City: NISKAYUNA
State: NY Zip: 12309

Source Category: ANNUAL EMISSIONS - DOE FACILITY
Source Type: Stack
Emission Year: 2009

Comments: KNOLLS 2009 ANNUAL EMISSIONS EVALUATION
MAXIMALLY EXPOSED INDIVIDUAL

Dataset Name: KNOLMEI09
Dataset Date: Mar 3, 2010 02:53 pm
Wind File: C:\CAP88PC2\WNDFILES\KAPL2009.WND

ORGAN DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Organ	Selected Individual (mrem/y)
GONADS	1.87E-04
BREAST	1.67E-04
R MAR	5.96E-04
LUNGS	5.48E-03
THYROID	1.73E-04
ENDOST	2.19E-03
RMNDR	2.28E-04
EFFEC	9.40E-04

Radon Decay Product Concentration (working level)

0.00E+00

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Pathway	Selected Individual (mrem/y)
INGESTION	1.27E-04
INHALATION	6.85E-04
AIR IMMERSION	3.32E-06
GROUND SURFACE	1.25E-04
INTERNAL	8.12E-04
EXTERNAL	1.28E-04
TOTAL	9.40E-04

Radon Decay Product Concentration (working level)

0.00E+00

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY
(RN-222 Working Level Calculations Excluded)

Nuclide	Selected Individual (mrem/y)
KR-85	4.94E-06
SR-90	7.37E-05
Y-90	2.35E-07
CS-137	2.20E-05
BA-137M	1.24E-04
U-238	1.07E-08
TH-234	6.53E-12
PA-234M	3.54E-14
U-234	6.35E-04
TH-230	0.00E+00
RA-226	0.00E+00
RN-222	0.00E+00
PO-218	0.00E+00
PB-214	0.00E+00
BI-214	0.00E+00
PO-214	0.00E+00
PB-210	0.00E+00
BI-210	0.00E+00
PO-210	2.65E-12
U-235	1.01E-05
U-236	1.88E-06
PU-238	5.17E-05
PU-239	1.60E-05
CO-60	5.63E-07
TOTAL	9.40E-04

Radon Decay Product Concentration (working level)

0.00E+00

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	1.54E-09
BONE	1.98E-10
THYROID	7.80E-11
BREAST	6.49E-10
LUNG	9.30E-09
STOMACH	4.07E-10
BOWEL	2.29E-10
LIVER	5.69E-10
PANCREAS	2.85E-10
URINARY	2.73E-10
OTHER	3.49E-10
TOTAL	1.39E-08

	Selected Individual Cancer Risk
Radon Decay Product Lung Exposure	0.00E+00
Total Fatal Risk All Exposures	1.39E-08

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	1.90E-09
INHALATION	8.91E-09
AIR IMMERSION	7.93E-11
GROUND SURFACE	2.99E-09
INTERNAL	1.08E-08
EXTERNAL	3.07E-09
TOTAL	1.39E-08

	Selected Individual Cancer Risk
Radon Decay Product Lung Exposure	0.00E+00
Total Fatal Risk All Exposures	1.39E-08

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
KR-85	1.39E-10
SR-90	1.24E-09
Y-90	8.05E-12
CS-137	5.76E-10
BA-137M	2.97E-09
U-238	1.40E-13
TH-234	2.19E-16
PA-234M	8.49E-19
U-234	8.20E-09
TH-230	0.00E+00
RA-226	0.00E+00
RN-222	0.00E+00
PO-218	0.00E+00
PB-214	0.00E+00
BI-214	0.00E+00
PO-214	0.00E+00
PB-210	0.00E+00
BI-210	0.00E+00
PO-210	1.39E-17
U-235	1.33E-10
U-236	2.42E-11
PU-238	4.42E-10
PU-239	1.26E-10
CO-60	1.41E-11
TOTAL	1.39E-08

	Selected Individual Cancer Risk
Radon Decay Product Lung Exposure	0.00E+00
Total Fatal Risk All Exposures	1.39E-08

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	5.7E-04	3.9E-04	2.4E-04	2.2E-04	2.0E-04	1.4E-04	1.3E-04
NNW	9.4E-04	6.4E-04*	4.1E-04	3.6E-04	3.3E-04	2.3E-04	2.1E-04
NW	3.9E-04	2.7E-04	1.7E-04*	1.5E-04	1.4E-04	9.8E-05	9.0E-05
WNW	2.0E-04	1.4E-04	9.2E-05	8.2E-05	7.7E-05*	5.5E-05	5.1E-05
W	1.8E-04	1.2E-04	8.0E-05	7.1E-05	6.7E-05	4.9E-05	4.5E-05
WSW	2.1E-04	1.5E-04	9.6E-05	8.5E-05	8.1E-05	5.8E-05	5.3E-05
SW	5.4E-04	3.7E-04	2.3E-04	2.1E-04	1.9E-04	1.3E-04	1.2E-04
SSW	4.6E-04	3.1E-04	2.0E-04	1.7E-04	1.6E-04	1.1E-04	1.0E-04
S	3.5E-04	2.4E-04	1.5E-04	1.3E-04	1.3E-04	8.7E-05	8.0E-05
SSE	4.2E-04	2.9E-04	1.8E-04	1.6E-04	1.5E-04	1.0E-04	9.5E-05
SE	8.1E-04	5.5E-04	3.4E-04	3.0E-04	2.8E-04	1.9E-04	1.7E-04
ESE	6.8E-04	4.7E-04	3.0E-04	2.6E-04	2.5E-04	1.7E-04	1.6E-04
E	5.4E-04	3.7E-04	2.4E-04	2.1E-04	2.0E-04	1.4E-04	1.2E-04
ENE	3.3E-04	2.3E-04	1.5E-04	1.3E-04	1.2E-04	8.5E-05	7.7E-05
NE	2.8E-04	1.9E-04	1.2E-04	1.1E-04	1.0E-04	7.1E-05	6.6E-05
NNE	2.6E-04	1.8E-04	1.2E-04	1.0E-04	9.7E-05	6.8E-05	6.2E-05

Location and dose of Maximally exposed individual

	Distance (m)				
Direction	1050	1300	1650	2550	80000
N	1.2E-04	8.4E-05	5.9E-05	3.3E-05	1.1E-05
NNW	1.9E-04	1.4E-04	9.3E-05	5.0E-05	1.1E-05
NW	8.3E-05	6.0E-05	4.3E-05	2.6E-05	1.1E-05
WNW	4.8E-05	3.6E-05	2.7E-05	1.8E-05	1.1E-05
W	4.2E-05	3.2E-05	2.5E-05	1.7E-05	1.1E-05
WSW	5.0E-05	3.7E-05	2.8E-05	1.9E-05	1.1E-05
SW	1.1E-04	8.1E-05	5.7E-05	3.2E-05	1.1E-05
SSW	9.5E-05	6.9E-05	4.9E-05	2.8E-05	1.1E-05
S	7.4E-05	5.4E-05	3.9E-05	2.4E-05	1.1E-05
SSE	8.8E-05	6.3E-05	4.5E-05	2.6E-05	1.1E-05
SE	1.6E-04	1.1E-04	7.8E-05	4.2E-05	1.1E-05
ESE	1.4E-04	1.0E-04	7.2E-05	4.0E-05	1.1E-05
E	1.2E-04	8.3E-05	5.9E-05	3.3E-05	1.1E-05
ENE	7.2E-05	5.3E-05	3.8E-05	2.3E-05	1.1E-05
NE	6.1E-05	4.5E-05	3.3E-05	2.1E-05	1.1E-05
NNE	5.8E-05	4.3E-05	3.2E-05	2.1E-05	1.1E-05

*For business locations, an occupancy factor of eight hours per day is used; therefore, the calculated doses for business locations are divided by a factor of three.

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	8.4E-09	5.7E-09	3.6E-09	3.2E-09	3.0E-09	2.1E-09	1.9E-09
NNW	1.4E-08	9.5E-09	6.0E-09	5.3E-09	5.0E-09	3.4E-09	3.1E-09
NW	5.8E-09	4.0E-09	2.5E-09	2.2E-09	2.1E-09	1.5E-09	1.4E-09
WNW	3.0E-09	2.1E-09	1.4E-09	1.2E-09	1.2E-09	8.4E-10	7.8E-10
W	2.6E-09	1.8E-09	1.2E-09	1.1E-09	1.0E-09	7.4E-10	6.9E-10
WSW	3.2E-09	2.2E-09	1.4E-09	1.3E-09	1.2E-09	8.8E-10	8.1E-10
SW	8.0E-09	5.5E-09	3.5E-09	3.1E-09	2.9E-09	2.0E-09	1.8E-09
SSW	6.8E-09	4.6E-09	2.9E-09	2.6E-09	2.4E-09	1.7E-09	1.5E-09
S	5.2E-09	3.5E-09	2.3E-09	2.0E-09	1.9E-09	1.3E-09	1.2E-09
SSE	6.3E-09	4.3E-09	2.7E-09	2.4E-09	2.2E-09	1.6E-09	1.4E-09
SE	1.2E-08	8.1E-09	5.1E-09	4.5E-09	4.2E-09	2.9E-09	2.6E-09
ESE	1.0E-08	6.9E-09	4.4E-09	3.9E-09	3.7E-09	2.5E-09	2.3E-09
E	8.0E-09	5.5E-09	3.5E-09	3.1E-09	2.9E-09	2.0E-09	1.9E-09
ENE	4.9E-09	3.4E-09	2.2E-09	1.9E-09	1.8E-09	1.3E-09	1.2E-09
NE	4.1E-09	2.8E-09	1.8E-09	1.6E-09	1.5E-09	1.1E-09	9.9E-10
NNE	3.9E-09	2.7E-09	1.7E-09	1.5E-09	1.4E-09	1.0E-09	9.4E-10

	Distance (m)				
Direction	1050	1300	1650	2550	80000
N	1.8E-09	1.3E-09	8.9E-10	5.1E-10	1.8E-10
NNW	2.9E-09	2.0E-09	1.4E-09	7.6E-10	1.8E-10
NW	1.3E-09	9.2E-10	6.6E-10	4.1E-10	1.8E-10
WNW	7.3E-10	5.6E-10	4.3E-10	2.9E-10	1.8E-10
W	6.5E-10	5.0E-10	3.9E-10	2.7E-10	1.7E-10
WSW	7.6E-10	5.8E-10	4.4E-10	3.0E-10	1.8E-10
SW	1.7E-09	1.2E-09	8.7E-10	5.0E-10	1.8E-10
SSW	1.4E-09	1.0E-09	7.4E-10	4.4E-10	1.8E-10
S	1.1E-09	8.2E-10	6.0E-10	3.7E-10	1.7E-10
SSE	1.3E-09	9.6E-10	6.9E-10	4.1E-10	1.7E-10
SE	2.4E-09	1.7E-09	1.2E-09	6.5E-10	1.8E-10
ESE	2.1E-09	1.5E-09	1.1E-09	6.1E-10	1.8E-10
E	1.7E-09	1.3E-09	8.9E-10	5.2E-10	1.8E-10
ENE	1.1E-09	8.0E-10	5.8E-10	3.7E-10	1.8E-10
NE	9.2E-10	6.9E-10	5.1E-10	3.3E-10	1.7E-10
NNE	8.8E-10	6.6E-10	4.9E-10	3.2E-10	1.7E-10

C A P 8 8 - P C

Version 2.00

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Individual Assessment
Mar 26, 2010 10:41 am

Facility: KAPL - KNOLLS SITE
Address: 2401 RIVER ROAD
City: NISKAYUNA
State: NY Zip: 12309

Source Category: ANNUAL EMISSIONS - DOE FACILITY
Source Type: Stack
Emission Year: 2009

Comments: KNOLLS 2009 ANNUAL EMISSIONS EVALUATION
MAXIMALLY EXPOSED INDIVIDUAL

Dataset Name: KNOLMEI09
Dataset Date: Mar 3, 2010 02:53 pm
Wind File: C:\CAP88PC2\WNDFILES\KAPL2009.WND

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class							
Dir	A	B	C	D	E	F	G	Wind Freq
N	1.025	1.742	3.114	2.066	1.115	0.825	0.000	0.066
NNW	1.207	2.433	3.868	2.907	1.343	0.984	0.000	0.147
NW	0.969	1.424	1.312	5.367	0.996	0.842	0.000	0.048
WNW	0.873	1.260	1.892	0.772	1.075	0.810	0.000	0.034
W	0.805	0.827	0.846	0.772	0.772	0.772	0.000	0.026
WSW	0.784	0.867	0.814	0.772	0.852	0.772	0.000	0.030
SW	0.990	1.970	1.655	2.630	1.623	0.921	0.000	0.076
SSW	0.873	3.734	4.373	4.373	1.867	0.890	0.000	0.040
S	0.790	2.572	0.000	0.000	2.572	0.775	0.000	0.028
SSE	0.810	2.968	0.000	4.373	1.187	0.789	0.000	0.033
SE	0.925	2.532	4.461	3.303	1.155	0.865	0.000	0.072
ESE	1.388	3.107	4.301	4.098	1.630	0.939	0.000	0.190
E	1.367	2.939	4.361	4.130	1.779	0.941	0.000	0.128
ENE	1.094	2.422	4.328	3.633	1.560	0.836	0.000	0.037
NE	1.123	1.379	2.974	1.469	1.103	0.801	0.000	0.024
NNE	0.952	1.823	4.373	1.377	0.966	0.809	0.000	0.022

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	1.408	2.487	4.280	3.196	1.564	0.938	0.000
NNW	1.700	3.029	4.395	3.566	1.933	1.326	0.000
NW	1.294	2.034	2.572	5.659	1.351	0.986	0.000
WNW	1.070	1.833	3.318	0.772	1.498	0.895	0.000
W	0.878	0.945	0.998	0.772	0.772	0.772	0.000
WSW	0.811	1.054	0.905	0.772	1.014	0.772	0.000
SW	1.338	2.692	2.415	2.948	2.121	1.188	0.000
SSW	1.070	3.933	4.373	4.373	2.572	1.114	0.000
S	0.831	2.572	0.000	0.000	2.572	0.783	0.000
SSE	0.893	3.155	0.000	4.373	1.672	0.829	0.000
SE	1.198	3.177	4.511	3.991	1.794	1.049	0.000
ESE	1.914	3.421	4.577	4.723	2.126	1.230	0.000
E	1.892	3.334	4.674	4.921	2.228	1.235	0.000
ENE	1.530	3.266	4.507	4.041	2.072	0.969	0.000
NE	1.577	2.464	4.588	2.088	1.544	0.867	0.000
NNE	1.258	2.572	4.373	2.270	1.289	0.890	0.000

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.1479	0.1095	0.0608	0.1756	0.1305	0.3756	0.0000
NNW	0.2263	0.1197	0.0614	0.1563	0.1205	0.3157	0.0000
NW	0.4988	0.0404	0.0096	0.0046	0.0666	0.3801	0.0000
WNW	0.6320	0.0743	0.0269	0.0033	0.0169	0.2466	0.0000
W	0.5243	0.1366	0.0706	0.0042	0.0089	0.2554	0.0000
WSW	0.5328	0.0734	0.0501	0.0233	0.0578	0.2625	0.0000
SW	0.4559	0.0687	0.0165	0.0433	0.0538	0.3617	0.0000
SSW	0.3144	0.0114	0.0058	0.0028	0.0141	0.6515	0.0000
S	0.3656	0.0120	0.0000	0.0000	0.0039	0.6186	0.0000
SSE	0.3127	0.0103	0.0000	0.0070	0.0067	0.6633	0.0000
SE	0.2153	0.0191	0.0286	0.0654	0.0701	0.6014	0.0000
ESE	0.0873	0.1060	0.1621	0.4392	0.0656	0.1398	0.0000
E	0.0804	0.1037	0.1456	0.3906	0.1028	0.1769	0.0000
ENE	0.1739	0.0791	0.0913	0.1557	0.0548	0.4452	0.0000
NE	0.1793	0.0756	0.0376	0.0706	0.0991	0.5378	0.0000
NNE	0.1886	0.0711	0.0255	0.0612	0.1073	0.5463	0.0000
TOTAL	0.2429	0.0824	0.0754	0.1860	0.0744	0.3389	0.0000

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 9.1 degrees C
282.26 K
Precipitation: 97.0 cm/y
Lid Height: 1000 meters
Surface Roughness Length: 0.010 meters
Height Of Wind Measurements: 10.0 meters
Average Wind Speed: 2.203 m/s

Vertical Temperature Gradients:
STABILITY E 0.073 k/m
STABILITY F 0.109 k/m
STABILITY G 0.146 k/m

C A P 8 8 - P C

Version 2.00

Clean Air Act Assessment Package - 1988

G E N E R A L D A T A

Non-Radon Individual Assessment
Mar 26, 2010 10:41 am

Facility: KAPL - KNOLLS SITE
Address: 2401 RIVER ROAD
City: NISKAYUNA
State: NY Zip: 12309

Source Category: ANNUAL EMISSIONS - DOE FACILITY
Source Type: Stack
Emission Year: 2009

Comments: KNOLLS 2009 ANNUAL EMISSIONS EVALUATION
MAXIMALLY EXPOSED INDIVIDUAL

Dataset Name: KNOLMEI09
Dataset Date: Mar 3, 2010 02:53 pm
Wind File: C:\CAP88PC2\WNDFILES\KAPL2009.WND

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

Nuclide	Clearance Class	Particle Size (microns)	Scavenging Coefficient (per second)	Dry Deposition Velocity (m/s)
KR-85	*	0.0	0.00E+00	0.00E+00
SR-90	D	1.0	9.70E-06	1.80E-03
Y-90	Y	1.0	9.70E-06	1.80E-03
CS-137	D	1.0	9.70E-06	1.80E-03
BA-137M	D	1.0	9.70E-06	1.80E-03
U-238	Y	1.0	9.70E-06	1.80E-03
TH-234	Y	1.0	9.70E-06	1.80E-03
PA-234M	Y	1.0	9.70E-06	1.80E-03
U-234	Y	1.0	9.70E-06	1.80E-03
TH-230	Y	1.0	9.70E-06	1.80E-03
RA-226	W	1.0	9.70E-06	1.80E-03
RN-222	*	0.0	0.00E+00	0.00E+00
PO-218	W	1.0	9.70E-06	1.80E-03
PB-214	D	1.0	9.70E-06	1.80E-03
BI-214	W	1.0	9.70E-06	1.80E-03
PO-214	W	1.0	9.70E-06	1.80E-03
PB-210	D	1.0	9.70E-06	1.80E-03
BI-210	W	1.0	9.70E-06	1.80E-03
PO-210	W	1.0	9.70E-06	1.80E-03
U-235	Y	1.0	9.70E-06	1.80E-03
U-236	Y	1.0	9.70E-06	1.80E-03
PU-238	Y	1.0	9.70E-06	1.80E-03
PU-239	Y	1.0	9.70E-06	1.80E-03
CO-60	Y	1.0	9.70E-06	1.80E-03

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	DECAY CONSTANT (PER DAY)		TRANSFER COEFFICIENT	
Nuclide	Radio-active (1)	Surface	Water	Milk (2)	Meat (3)
KR-85	0.00E+00	5.48E-05	0.00E+00	0.00E+00	0.00E+00
SR-90	0.00E+00	5.48E-05	0.00E+00	1.50E-03	3.00E-04
Y-90	2.60E-01	5.48E-05	0.00E+00	2.00E-05	3.00E-04
CS-137	0.00E+00	5.48E-05	0.00E+00	7.00E-03	2.00E-02
BA-137M	3.91E+02	5.48E-05	0.00E+00	3.50E-04	1.50E-04
U-238	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
TH-234	2.88E-02	5.48E-05	0.00E+00	5.00E-06	6.00E-06
PA-234M	8.53E+02	5.48E-05	0.00E+00	5.00E-06	1.00E-05
U-234	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
TH-230	0.00E+00	5.48E-05	0.00E+00	5.00E-06	6.00E-06
RA-226	0.00E+00	5.48E-05	0.00E+00	4.50E-04	2.50E-04
RN-222	1.81E-01	5.48E-05	0.00E+00	0.00E+00	0.00E+00
PO-218	3.27E+02	5.48E-05	0.00E+00	3.50E-04	9.50E-05
PB-214	3.72E+01	5.48E-05	0.00E+00	2.50E-04	3.00E-04
BI-214	5.02E+01	5.48E-05	0.00E+00	5.00E-04	4.00E-04
PO-214	3.66E+08	5.48E-05	0.00E+00	3.50E-04	9.50E-05
PB-210	0.00E+00	5.48E-05	0.00E+00	2.50E-04	3.00E-04
BI-210	1.38E-01	5.48E-05	0.00E+00	5.00E-04	4.00E-04
PO-210	0.00E+00	5.48E-05	0.00E+00	3.50E-04	9.50E-05
U-235	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
U-236	0.00E+00	5.48E-05	0.00E+00	6.00E-04	2.00E-04
PU-238	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
PU-239	0.00E+00	5.48E-05	0.00E+00	1.00E-07	5.00E-07
CO-60	0.00E+00	5.48E-05	0.00E+00	2.00E-03	2.00E-02

FOOTNOTES:
(1) Effective radioactive decay constant in plume; set to zero if less than 1.0E-2

(2) Fraction of animal's daily intake of nuclide which appears in each L of milk (days/L)

(3) Fraction of animal's daily intake of nuclide which appears in each kg of meat (days/kg)

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

	CONCENTRATION UPTAKE FACTOR		GI UPTAKE FRACTION	
Nuclide	Forage (1)	Edible (2)	Inhalation	Ingestion
KR-85	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	2.50E+00	1.07E-01	3.00E-01	3.00E-01
Y-90	1.50E-02	2.57E-03	1.00E-04	1.00E-04
CS-137	8.00E-02	1.28E-02	9.50E-01	9.50E-01
BA-137M	1.50E-01	6.42E-03	1.00E-01	1.00E-01
U-238	8.50E-03	1.71E-03	2.00E-03	2.00E-01
TH-234	8.50E-04	3.64E-05	2.00E-04	2.00E-04
PA-234M	2.50E-03	1.07E-04	1.00E-03	1.00E-03
U-234	8.50E-03	1.71E-03	2.00E-03	2.00E-01
TH-230	8.50E-04	3.64E-05	2.00E-04	2.00E-04
RA-226	1.50E-02	6.42E-04	2.00E-01	2.00E-01
RN-222	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PO-218	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-214	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-214	3.50E-02	2.14E-03	5.00E-02	5.00E-02
PO-214	2.50E-03	1.71E-04	1.00E-01	1.00E-01
PB-210	4.50E-02	3.85E-03	2.00E-01	2.00E-01
BI-210	3.50E-02	2.14E-03	5.00E-02	5.00E-02
PO-210	2.50E-03	1.71E-04	1.00E-01	1.00E-01
U-235	8.50E-03	1.71E-03	2.00E-03	2.00E-01
U-236	8.50E-03	1.71E-03	2.00E-03	2.00E-01
PU-238	4.50E-04	1.93E-05	1.00E-03	1.00E-03
PU-239	4.50E-04	1.93E-05	1.00E-04	1.00E-03
CO-60	2.00E-02	3.00E-03	5.00E-02	3.00E-01

FOOTNOTES: (1) Concentration factor for uptake of nuclide from soil for pasture and forage (in pCi/kg dry weight per pCi/kg dry soil)

(2) Concentration factor for uptake of nuclide from soil by edible parts of crops (in pCi/kg wet weight per pCi/kg dry soil)

DECAY CHAIN INGROWTH FACTORS

Nuclide	Parent(s)	Ingrowth Factor(s)
Y-90	SR-90	2.090E+03
BA-137M	CS-137	3.209E+06
PA-234M	TH-234	2.961E+04
RA-226	TH-230	1.490E-02
PB-214	TH-230	6.915E+03
	RA-226	4.635E+05
	PO-218	1.138E-01
BI-214	TH-230	9.313E+03
	RA-226	6.240E+05
	PO-218	1.532E-01
	PB-214	1.347E+00
PO-210	U-238	3.560E+01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

HUMAN INHALATION RATE	
Cubic centimeters/hr	9.17E+05
SOIL PARAMETERS	
Effective surface density (kg/sq m, dry weight) (Assumes 15 cm plow layer)	2.15E+02
BUILDUP TIMES	
For activity in soil (years)	1.00E+02
For radionuclides deposited on ground/water (days)	3.65E+04
DELAY TIMES	
Ingestion of pasture grass by animals (hr)	0.00E+00
Ingestion of stored feed by animals (hr)	2.16E+03
Ingestion of leafy vegetables by man (hr)	3.36E+02
Ingestion of produce by man (hr)	3.36E+02
Transport time from animal feed-milk-man (day)	2.00E+00
Time from slaughter to consumption (day)	2.00E+01
WEATHERING	
Removal rate constant for physical loss (per hr)	2.90E-03
CROP EXPOSURE DURATION	
Pasture grass (hr)	7.20E+02
Crops/leafy vegetables (hr)	1.44E+03
AGRICULTURAL PRODUCTIVITY	
Grass-cow-milk-man pathway (kg/sq m)	2.80E-01
Produce/leafy veg for human consumption (kg/sq m)	7.16E-01
FALLOUT INTERCEPTION FRACTIONS	
Vegetables	2.00E-01
Pasture	5.70E-01
GRAZING PARAMETERS	
Fraction of year animals graze on pasture	4.00E-01
Fraction of daily feed that is pasture grass when animal grazes on pasture	4.30E-01

VALUES FOR RADIONUCLIDE-INDEPENDENT PARAMETERS

ANIMAL FEED CONSUMPTION FACTORS	
Contaminated feed/forage (kg/day, dry weight)	1.56E+01
DAIRY PRODUCTIVITY	
Milk production of cow (L/day)	1.10E+01
MEAT ANIMAL SLAUGHTER PARAMETERS	
Muscle mass of animal at slaughter (kg)	2.00E+02
Fraction of herd slaughtered (per day)	3.81E-03
DECONTAMINATION	
Fraction of radioactivity retained after washing for leafy vegetables and produce	5.00E-01
FRACTIONS GROWN IN GARDEN OF INTEREST	
Produce ingested	1.00E+00
Leafy vegetables ingested	1.00E+00
INGESTION RATIOS:	
IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	
Vegetables	7.00E-01
Meat	4.42E-01
Milk	3.99E-01
MINIMUM INGESTION FRACTIONS FROM OUTSIDE AREA (Minimum fractions of food types from outside area listed below are actual fixed values.)	
Vegetables	0.00E+00
Meat	0.00E+00
Milk	0.00E+00
HUMAN FOOD UTILIZATION FACTORS	
Produce ingestion (kg/y)	1.76E+02
Milk ingestion (L/y)	1.12E+02
Meat ingestion (kg/y)	8.50E+01
Leafy vegetable ingestion (kg/y)	1.80E+01
SWIMMING PARAMETERS	
Fraction of time spent swimming	0.00E+00
Dilution factor for water (cm)	1.00E+00

APPENDIX B

Separations Process Research Unit

Land Area

(SPRU LA)

CAP88-PC OUTPUT

Lower Level and North Field Sites

CAP88-PC Calculation Output

2009 Annual Release

Distance to Maximally Exposed Individual: 450 m in the SW sector

CAP88-PC Calculated Dose Equivalent: 9.7E-06 mrem/yr

The following paragraph provides a brief summary of how the location of the maximally exposed individual is determined:

The distance to the closest residence and/or business in each of the 16 sectors surrounding the site was supplied by KAPL and determined using Arcview GIS software. The distance and direction to the maximally exposed individual is 450 m in the southwest sector. The residence receptor locations are underlined on page 5 of the *Dose and Risk Equivalent Summaries* report included in the CAP88-PC output. For business locations, an occupancy factor of 8 hours per day was utilized when evaluating doses. These locations are indicated by an asterisk "*" after the dose.

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Nov 8, 2011 09:55 am

Facility: aRc 2009
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Non-Point Release
Source Type: Area
Emission Year: 2009

Comments: aRc 2009 Releases
Lower Level and North Field

Effective Dose Equivalent (mrem/year)
9.66E-06

At This Location: 450 Meters Southwest

Dataset Name: 2009aRc
Dataset Date: 11/8/2011 9:54:00 AM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2009.WND

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters Southwest
Lifetime Fatal Cancer Risk: 2.26E-12

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y)
Adrenals	6.41E-07
B Surfac	1.67E-05
Breasts	5.23E-07
St Wall	6.16E-07
ULI Wall	7.02E-07
Kidneys	6.68E-07
Lungs	1.10E-06
Ovaries	7.97E-07
R Marrow	2.64E-06
Spleen	6.19E-07
Thymus	6.02E-07
Uterus	6.58E-07
Bld Wall	6.66E-07
Brain	5.46E-07
Esophagu	7.06E-07
SI Wall	6.44E-07
LLI Wall	9.31E-07
Liver	3.27E-06
Muscle	5.80E-07
Pancreas	6.56E-07
Skin	6.16E-07
Testes	7.29E-07
Thyroid	6.02E-07
EFFEC	9.66E-06

RADIONUCLIDE EMISSIONS DURING THE YEAR 2009

Nuclide	Type	Size	Source #1 Ci/y	Source #2 Ci/y	TOTAL Ci/y
Cs-137	F	1	2.4E-08	7.8E-11	2.4E-08
Ba-137m	M	1	2.4E-08	7.8E-11	2.4E-08
Pu-238	M	1	3.7E-10	1.2E-10	5.0E-10
Pu-239	M	1	2.1E-09	2.1E-09	4.2E-09
Pu-240	M	1	2.1E-09	2.1E-09	4.2E-09
U-234	M	1	7.0E-09	1.6E-09	8.7E-09
U-235	M	1	5.3E-10	8.0E-11	6.2E-10
U-238	M	1	1.2E-09	1.8E-10	1.4E-09
Pb-214	M	1	2.0E-09	3.9E-10	2.4E-09
Bi-214	M	1	0.0E+00	0.0E+00	0.0E+00
Po-214	M	1	0.0E+00	0.0E+00	0.0E+00
Pb-210	M	1	0.0E+00	0.0E+00	0.0E+00
Bi-210	M	1	0.0E+00	0.0E+00	0.0E+00
Po-210	M	1	0.0E+00	0.0E+00	0.0E+00
Sr-90	M	1	4.9E-09	6.1E-10	5.5E-09
Y-90	M	1	4.9E-09	6.1E-10	5.5E-09
Pu-241	M	1	8.7E-09	1.8E-09	1.1E-08
Am-241	M	1	5.3E-10	1.2E-10	6.5E-10
Bi-212	M	1	1.9E-09	0.0E+00	1.9E-09
Po-212	M	1	0.0E+00	0.0E+00	0.0E+00
Tl-208	M	1	8.2E-10	1.4E-10	9.6E-10
Pb-212	M	1	2.0E-09	4.0E-10	2.4E-09

SITE INFORMATION

Temperature: 9 degrees C
Precipitation: 97 cm/y
Humidity: 8 g/cu m
Mixing Height: 1000 m

User specified location of max exposed individual.
(ILOC, JLOC): 7, 1

SOURCE INFORMATION

Source Number:	1	2
Source Height (m):	1.00	1.00
Area (sq m):	16187.00	4047.00

Plume Rise Pasquill Cat:	A	B	C	D	E	F	G
Zero:	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.400	0.440
Fraction From Assessment Area:	0.300	0.600	0.560
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

450	550	700	750	775	950	1000
1050	1300	1650	2550			

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Individual Assessment
Nov 8, 2011 09:55 am

Facility: aRc 2009
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Non-Point Release
Source Type: Area
Emission Year: 2009

Comments: aRc 2009 Releases
Lower Level and North Field

Dataset Name: 2009aRc
Dataset Date: 11/8/2011 9:54:00 AM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2009.WND

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
Adrenals	6.41E-07
B Surfac	1.67E-05
Breasts	5.23E-07
St Wall	6.16E-07
ULI Wall	7.02E-07
Kidneys	6.68E-07
Lungs	1.10E-06
Ovaries	7.97E-07
R Marrow	2.64E-06
Spleen	6.19E-07
Thymus	6.02E-07
Uterus	6.58E-07
Bld Wall	6.66E-07
Brain	5.46E-07
Esophagu	7.06E-07
SI Wall	6.44E-07
LLI Wall	9.31E-07
Liver	3.27E-06
Muscle	5.80E-07
Pancreas	6.56E-07
Skin	6.16E-07
Testes	7.29E-07
Thyroid	6.02E-07
EFFEC	9.66E-06

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	9.11E-07
INHALATION	8.73E-06
AIR IMMERSION	4.87E-11
GROUND SURFACE	1.86E-08
INTERNAL	9.65E-06
EXTERNAL	1.87E-08
TOTAL	9.66E-06

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
Cs-137	5.75E-07
Ba-137m	1.78E-08
Pu-238	0.00E+00
U-234	5.99E-07
Th-230	0.00E+00
Ra-226	0.00E+00
Rn-222	0.00E+00
Po-218	0.00E+00
Pb-214	4.12E-10
Bi-214	0.00E+00
Po-214	0.00E+00
Pb-210	0.00E+00
Bi-210	0.00E+00
Po-210	0.00E+00
At-218	0.00E+00
Pu-239	3.99E-06
U-235	0.00E+00
Th-231	0.00E+00
Pa-231	0.00E+00
Ac-227	0.00E+00
Th-227	0.00E+00
Ra-223	0.00E+00
Rn-219	0.00E+00
Po-215	0.00E+00
Pb-211	0.00E+00
Fr-223	0.00E+00
Pu-240	3.99E-06
U-236	0.00E+00
Th-232	0.00E+00
Ra-228	0.00E+00
Ac-228	0.00E+00
U-238	6.58E-08
Th-234	0.00E+00
Pa-234m	0.00E+00
Pa-234	0.00E+00
Sr-90	2.28E-07
Y-90	8.85E-10
Pu-241	1.82E-07
Am-241	0.00E+00
Np-237	0.00E+00
Pa-233	0.00E+00
U-233	0.00E+00
Th-229	0.00E+00
Ra-225	0.00E+00
Ac-225	0.00E+00
Fr-221	0.00E+00
At-217	0.00E+00
U-237	0.00E+00
Pb-212	6.42E-09
Bi-212	1.12E-09
Po-212	0.00E+00
Tl-208	0.00E+00
TOTAL	9.66E-06

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
Esophagu	9.78E-15
Stomach	3.13E-14
Colon	1.04E-13
Liver	4.97E-13
LUNG	1.11E-12
Bone	1.40E-13
Skin	8.00E-16
Breast	2.39E-14
Ovary	3.60E-14
Bladder	2.44E-14
Kidneys	9.79E-15
Thyroid	2.24E-15
Leukemia	1.61E-13
Residual	1.12E-13
Total	2.26E-12
TOTAL	4.52E-12

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	4.44E-13
INHALATION	1.81E-12
AIR IMMERSION	2.64E-17
GROUND SURFACE	9.69E-15
INTERNAL	2.25E-12
EXTERNAL	9.71E-15
TOTAL	2.26E-12

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Cs-137	2.92E-13
Ba-137m	9.60E-15
Pu-238	0.00E+00
U-234	4.84E-13
Th-230	0.00E+00
Ra-226	0.00E+00
Rn-222	0.00E+00
Po-218	0.00E+00
Pb-214	2.82E-16
Bi-214	0.00E+00
Po-214	0.00E+00
Pb-210	0.00E+00
Bi-210	0.00E+00
Po-210	0.00E+00
At-218	0.00E+00
Pu-239	6.32E-13
U-235	0.00E+00
Th-231	0.00E+00
Pa-231	0.00E+00
Ac-227	0.00E+00
Th-227	0.00E+00
Ra-223	0.00E+00
Rn-219	0.00E+00
Po-215	0.00E+00
Pb-211	0.00E+00
Fr-223	0.00E+00
Pu-240	6.33E-13
U-236	0.00E+00
Th-232	0.00E+00
Ra-228	0.00E+00
Ac-228	0.00E+00
U-238	5.48E-14
Th-234	0.00E+00
Pa-234m	0.00E+00
Pa-234	0.00E+00
Sr-90	1.34E-13
Y-90	2.38E-16
Pu-241	1.56E-14
Am-241	0.00E+00
Np-237	0.00E+00
Pa-233	0.00E+00
U-233	0.00E+00
Th-229	0.00E+00
Ra-225	0.00E+00
Ac-225	0.00E+00
Fr-221	0.00E+00
At-217	0.00E+00
U-237	0.00E+00
Pb-212	5.53E-15
Bi-212	7.24E-16
Po-212	0.00E+00
Tl-208	0.00E+00
TOTAL	2.26E-12

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	1.0E-05	6.9E-06	4.4E-06	3.8E-06	3.6E-06	2.5E-06	2.2E-06
NNW	1.7E-05	1.1E-05*	7.2E-06	6.3E-06	5.9E-06	4.0E-06	3.7E-06
NW	7.0E-06	4.7E-06	3.0E-06*	2.6E-06	2.5E-06	1.7E-06	1.6E-06
WNW	3.6E-06	2.5E-06	1.6E-06	1.4E-06	1.3E-06*	9.5E-07	8.8E-07
W	3.1E-06	2.1E-06	1.4E-06	1.2E-06	1.2E-06	8.3E-07	7.7E-07
WSW	3.8E-06	2.6E-06	1.7E-06	1.5E-06	1.4E-06	9.9E-07	9.1E-07
SW	9.7E-06	6.6E-06	4.1E-06	3.6E-06	3.4E-06	2.3E-06	2.1E-06
SSW	8.2E-06	5.6E-06	3.5E-06	3.1E-06	2.9E-06	2.0E-06	1.8E-06
S	6.3E-06	4.3E-06	2.7E-06	2.4E-06	2.2E-06	1.5E-06	1.4E-06
SSE	7.6E-06	5.2E-06	3.2E-06	2.8E-06	2.7E-06	1.8E-06	1.7E-06
SE	1.4E-05	9.8E-06	6.1E-06	5.4E-06	5.0E-06	3.4E-06	3.1E-06
ESE	1.2E-05	8.3E-06	5.3E-06	4.6E-06	4.4E-06	3.0E-06	2.7E-06
E	9.7E-06	6.7E-06	4.2E-06	3.7E-06	3.5E-06	2.4E-06	2.2E-06
ENE	6.0E-06	4.1E-06	2.6E-06	2.3E-06	2.1E-06	1.5E-06	1.4E-06
NE	5.0E-06	3.4E-06	2.2E-06	1.9E-06	1.8E-06	1.3E-06	1.2E-06
NNE	4.7E-06	3.2E-06	2.1E-06	1.8E-06	1.7E-06	1.2E-06	1.1E-06

	Distance (m)			
Direction	1050	1300	1650	2550
N	2.1E-06	1.5E-06	1.0E-06	5.7E-07
NNW	3.4E-06	2.4E-06	1.6E-06	8.5E-07
NW	1.4E-06	1.0E-06	7.4E-07	4.4E-07
WNW	8.1E-07	6.1E-07	4.6E-07	3.1E-07
W	7.2E-07	5.4E-07	4.1E-07	2.8E-07
WSW	8.5E-07	6.4E-07	4.7E-07	3.1E-07
SW	2.0E-06	1.4E-06	9.8E-07	5.5E-07
SSW	1.7E-06	1.2E-06	8.5E-07	4.8E-07
S	1.3E-06	9.4E-07	6.7E-07	4.0E-07
SSE	1.5E-06	1.1E-06	7.8E-07	4.5E-07
SE	2.8E-06	2.0E-06	1.4E-06	7.3E-07
ESE	2.5E-06	1.8E-06	1.2E-06	6.7E-07
E	2.0E-06	1.5E-06	1.0E-06	5.7E-07
ENE	1.3E-06	9.2E-07	6.6E-07	4.0E-07
NE	1.1E-06	7.9E-07	5.8E-07	3.6E-07
NNE	1.0E-06	7.6E-07	5.5E-07	3.5E-07

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	2.4E-12	1.6E-12	1.0E-12	9.3E-13	8.7E-13	6.1E-13	5.6E-13
NNW	3.9E-12	2.7E-12	1.7E-12	1.5E-12	1.4E-12	9.8E-13	8.9E-13
NW	1.6E-12	1.1E-12	7.4E-13	6.6E-13	6.2E-13	4.4E-13	4.1E-13
WNW	8.8E-13	6.2E-13	4.2E-13	3.8E-13	3.6E-13	2.7E-13	2.5E-13
W	7.6E-13	5.4E-13	3.7E-13	3.3E-13	3.2E-13	2.4E-13	2.3E-13
WSW	9.2E-13	6.5E-13	4.4E-13	3.9E-13	3.7E-13	2.8E-13	2.6E-13
SW	2.3E-12	1.6E-12	1.0E-12	8.8E-13	8.3E-13	5.9E-13	5.4E-13
SSW	1.9E-12	1.3E-12	8.5E-13	7.6E-13	7.1E-13	5.1E-13	4.7E-13
S	1.5E-12	1.0E-12	6.7E-13	5.9E-13	5.6E-13	4.0E-13	3.7E-13
SSE	1.8E-12	1.2E-12	7.9E-13	7.0E-13	6.6E-13	4.7E-13	4.3E-13
SE	3.4E-12	2.3E-12	1.5E-12	1.3E-12	1.2E-12	8.3E-13	7.6E-13
ESE	2.8E-12	2.0E-12	1.3E-12	1.1E-12	1.1E-12	7.4E-13	6.8E-13
E	2.3E-12	1.6E-12	1.0E-12	9.0E-13	8.5E-13	6.0E-13	5.5E-13
ENE	1.4E-12	9.8E-13	6.4E-13	5.7E-13	5.4E-13	3.9E-13	3.6E-13
NE	1.2E-12	8.3E-13	5.5E-13	4.9E-13	4.6E-13	3.4E-13	3.1E-13
NNE	1.1E-12	7.8E-13	5.2E-13	4.6E-13	4.4E-13	3.2E-13	3.0E-13

	Distance (m)			
Direction	1050	1300	1650	2550
N	5.2E-13	3.9E-13	2.8E-13	1.8E-13
NNW	8.2E-13	6.0E-13	4.2E-13	2.5E-13
NW	3.8E-13	2.9E-13	2.2E-13	1.5E-13
WNW	2.4E-13	1.9E-13	1.6E-13	1.2E-13
W	2.2E-13	1.8E-13	1.4E-13	1.1E-13
WSW	2.5E-13	2.0E-13	1.6E-13	1.2E-13
SW	5.0E-13	3.7E-13	2.8E-13	1.8E-13
SSW	4.3E-13	3.3E-13	2.4E-13	1.6E-13
S	3.5E-13	2.7E-13	2.0E-13	1.4E-13
SSE	4.0E-13	3.0E-13	2.3E-13	1.5E-13
SE	7.0E-13	5.1E-13	3.6E-13	2.2E-13
ESE	6.3E-13	4.6E-13	3.4E-13	2.1E-13
E	5.2E-13	3.8E-13	2.8E-13	1.8E-13
ENE	3.4E-13	2.6E-13	2.0E-13	1.4E-13
NE	2.9E-13	2.3E-13	1.8E-13	1.3E-13
NNE	2.8E-13	2.2E-13	1.8E-13	1.3E-13

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Version 3.0

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Individual Assessment
Nov 8, 2011 09:55 am

Facility: aRc 2009
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Non-Point Release
Source Type: Area
Emission Year: 2009

Comments: aRc 2009 Releases
Lower Level and North Field

Dataset Name: 2009aRc
Dataset Date: 11/8/2011 9:54:00 AM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2009.WND

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class							
Dir	A	B	C	D	E	F	G	Wind Freq
N	1.025	1.742	3.114	2.066	1.115	0.825	0.000	0.066
NNW	1.207	2.433	3.868	2.907	1.343	0.984	0.000	0.147
NW	0.969	1.424	1.312	5.367	0.996	0.842	0.000	0.048
WNW	0.873	1.260	1.892	0.772	1.075	0.810	0.000	0.034
W	0.805	0.827	0.846	0.772	0.772	0.772	0.000	0.026
WSW	0.784	0.867	0.814	0.772	0.852	0.772	0.000	0.030
SW	0.990	1.970	1.655	2.630	1.623	0.921	0.000	0.076
SSW	0.873	3.734	4.373	4.373	1.867	0.890	0.000	0.040
S	0.790	2.572	0.000	0.000	2.572	0.775	0.000	0.028
SSE	0.810	2.968	0.000	4.373	1.187	0.789	0.000	0.033
SE	0.925	2.532	4.461	3.303	1.155	0.865	0.000	0.072
ESE	1.388	3.107	4.301	4.098	1.630	0.939	0.000	0.190
E	1.367	2.939	4.361	4.130	1.779	0.941	0.000	0.128
ENE	1.094	2.422	4.328	3.633	1.560	0.836	0.000	0.037
NE	1.123	1.379	2.974	1.469	1.103	0.801	0.000	0.024
NNE	0.952	1.823	4.373	1.377	0.966	0.809	0.000	0.022

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	1.408	2.487	4.280	3.196	1.564	0.938	0.000
NNW	1.700	3.029	4.395	3.566	1.933	1.326	0.000
NW	1.294	2.034	2.572	5.659	1.351	0.986	0.000
WNW	1.070	1.833	3.318	0.772	1.498	0.895	0.000
W	0.878	0.945	0.998	0.772	0.772	0.772	0.000
WSW	0.811	1.054	0.905	0.772	1.014	0.772	0.000
SW	1.338	2.692	2.415	2.948	2.121	1.188	0.000
SSW	1.070	3.933	4.373	4.373	2.572	1.114	0.000
S	0.831	2.572	0.000	0.000	2.572	0.783	0.000
SSE	0.893	3.155	0.000	4.373	1.672	0.829	0.000
SE	1.198	3.177	4.511	3.991	1.794	1.049	0.000
ESE	1.914	3.421	4.577	4.723	2.126	1.230	0.000
E	1.892	3.334	4.674	4.921	2.228	1.235	0.000
ENE	1.530	3.266	4.507	4.041	2.072	0.969	0.000
NE	1.577	2.464	4.588	2.088	1.544	0.867	0.000
NNE	1.258	2.572	4.373	2.270	1.289	0.890	0.000

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.1479	0.1095	0.0608	0.1756	0.1305	0.3756	0.0000
NNW	0.2263	0.1197	0.0614	0.1563	0.1205	0.3157	0.0000
NW	0.4988	0.0404	0.0096	0.0046	0.0666	0.3801	0.0000
WNW	0.6320	0.0743	0.0269	0.0033	0.0169	0.2466	0.0000
W	0.5243	0.1366	0.0706	0.0042	0.0089	0.2554	0.0000
WSW	0.5328	0.0734	0.0501	0.0233	0.0578	0.2625	0.0000
SW	0.4559	0.0687	0.0165	0.0433	0.0538	0.3617	0.0000
SSW	0.3144	0.0114	0.0058	0.0028	0.0141	0.6515	0.0000
S	0.3656	0.0120	0.0000	0.0000	0.0039	0.6186	0.0000
SSE	0.3127	0.0103	0.0000	0.0070	0.0067	0.6633	0.0000
SE	0.2153	0.0191	0.0286	0.0654	0.0701	0.6014	0.0000
ESE	0.0873	0.1060	0.1621	0.4392	0.0656	0.1398	0.0000
E	0.0804	0.1037	0.1456	0.3906	0.1028	0.1769	0.0000
ENE	0.1739	0.0791	0.0913	0.1557	0.0548	0.4452	0.0000
NE	0.1793	0.0756	0.0376	0.0706	0.0991	0.5378	0.0000
NNE	0.1886	0.0711	0.0255	0.0612	0.1073	0.5463	0.0000
TOTAL	0.2429	0.0824	0.0754	0.1860	0.0744	0.3389	0.0000

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 9.1 degrees C
282.26 K
Precipitation: 97.0 cm/y
Humidity: 8.0 g/cu m
Lid Height: 1000 meters
Surface Roughness Length: 0.010 meters
Height Of Wind Measurements: 10.0 meters
Average Wind Speed: 2.203 m/s

Vertical Temperature Gradients:
STABILITY E 0.073 k/m
STABILITY F 0.109 k/m
STABILITY G 0.146 k/m

APPENDIX C

Separations Process Research Unit

Disposition Project

(SPRU DP)

CAP88-PC OUTPUT

SPRU DP

CAP-88PC Calculation Output

2009 Annual Release

Distance to Maximally Exposed Individual: 450 meters in the southwest sector

CAP-88PC Calculated Dose Equivalent: 5.4E-05 mrem/yr

Brief Summary of how the location of the maximally exposed individual is determined:

The distance to the closest residence and/or business in each of the 16 sectors surrounding the Site was determined using the Arcview GIS software. The CAP-88PC code calculates the dose equivalent at each distance entered and in each of the 16 sectors whether or not an actual residence/business is located there and the highest dose calculated is shown on the first page of the CAP-88PC output. Therefore, for each sector the dose equivalent at the closest residence/business was checked to determine which sector location and distance results in the highest potential dose equivalent to a resident. These locations are underlined on page 5 of the "Dose and Risk Equivalent Summaries" report included in the CAP-88PC output. For business locations, an occupancy factor of 8 hours per day was utilized when evaluating doses.

The distance and direction to the maximally exposed individual is approximately 450 meters in the southwest sector.

ATTACHMENTS A through E

CAP88-PC OUTPUT REPORTS

ATTACHMENT A

CAP88-PC OUTPUT

SPRU Point Sources

Synopsis

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Nov 2, 2011 03:18 pmm

Facility: SPRU DP
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: point sources
Source Type: Stack
Emission Year: 2009

Comments: 2009 compliance report
H2, G2, Tank Farm releases

Effective Dose Equivalent (mrem/year)
5.44E-05

At This Location: 450 Meters Southwest

Dataset Name: 2010 Point EDE
Dataset Date: 11/2/2011 3:17:00 PM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL200

Nov 2, 2011 03:18 pmm SYNOPSIS
Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters Southwest
Lifetime Fatal Cancer Risk: 1.68E-11

Nov 2, 2011 03:18 pmm SYNOPSIS
Page 2

RADIONUCLIDE EMISSIONS DURING THE YEAR 2009

Nuclide	Type	Size	Source #1 Ci/y	Source #2 Ci/y	TOTAL Ci/y
Cs-137	F	1	4.0E-06	5.2E-07	4.5E-06
Ba-137m	M	1	4.0E-06	5.2E-07	4.5E-06
Sr-90	M	1	7.4E-07	9.8E-08	8.4E-07
Y-90	M	1	7.4E-07	9.8E-08	8.4E-07
Pu-239	M	1	1.8E-07	2.8E-08	2.1E-07
Pu-241	M	1	9.8E-08	1.5E-08	1.1E-07
Am-241	M	1	2.9E-08	4.5E-09	3.4E-08

SITE INFORMATION

Temperature: 9 degrees C
Precipitation: 97 cm/y
Humidity: 8 g/cu m
Mixing Height: 1000 m

User specified location of max exposed individual.
(ILOC, JLOC): 7, 1

SOURCE INFORMATION

Source Number:	1	2
Stack Height (m):	18.29	12.19
Diameter (m):	0.97	0.30
Plume Rise Momentum (m/s): (Exit Velocity)	5.09	0.00

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.400	0.440
Fraction From Assessment Area:	0.300	0.600	0.560
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

450	550	700	750	775	950	1000
1050	1300	1650	2550			

ATTACHMENT B

CAP88-PC OUTPUT

SPRU Point Sources
Dose & Risk Equivalent

Summary

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S

Non-Radon Individual Assessment
Nov 2, 2011 03:18 pmm

Facility: SPRU DP
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: point sources
Source Type: Stack
Emission Year: 2009

Comments: 2009 compliance report
H2, G2, Tank Farm releases

Dataset Name: 2010 Point EDE
Dataset Date: 11/2/2011 3:17:00 PM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2009.WND

Nov 2, 2011 03:18 pmm

SUMMARY
Page 1

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	2.22E-05
INHALATION	3.18E-05
AIR IMMERSION	1.18E-09
GROUND SURFACE	4.71E-07
INTERNAL	5.40E-05
EXTERNAL	4.72E-07
TOTAL	5.44E-05

Nov 2, 2011 03:18 pmm

SUMMARY
Page 2

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
Cs-137	1.62E-05
Ba-137m	4.52E-07
Sr-90	5.58E-06
Y-90	2.00E-08
Pu-239	2.82E-05
U-235	0.00E+00
Th-231	0.00E+00
Pu-241	2.75E-07
Am-241	3.71E-06
Np-237	0.00E+00
Pa-233	0.00E+00
U-233	0.00E+00
Th-229	0.00E+00
U-237	0.00E+00
TOTAL	5.44E-05

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
Esophagu	1.87E-13
Stomach	6.57E-13
Colon	2.23E-12
Liver	2.06E-12
LUNG	3.53E-12
Bone	6.80E-13
Skin	1.58E-14
Breast	5.44E-13
Ovary	3.35E-13
Bladder	4.78E-13
Kidneys	1.06E-13
Thyroid	4.54E-14
Leukemia	3.55E-12
Residual	2.39E-12
Total	1.68E-11
TOTAL	3.36E-11

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	1.15E-11
INHALATION	5.08E-12
AIR IMMERSION	6.43E-16
GROUND SURFACE	2.46E-13
INTERNAL	1.66E-11
EXTERNAL	2.47E-13
TOTAL	1.68E-11

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Cs-137	8.21E-12
Ba-137m	2.44E-13
Sr-90	3.28E-12
Y-90	5.48E-15
Pu-239	4.46E-12
U-235	0.00E+00
Th-231	0.00E+00
Pu-241	2.35E-14
Am-241	5.86E-13
Np-237	0.00E+00
Pa-233	0.00E+00
U-233	0.00E+00
Th-229	0.00E+00
U-237	0.00E+00
TOTAL	1.68E-11

Nov 2, 2011 03:18 pmm

SUMMARY
Page 5

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	5.1E-05	4.6E-05	4.0E-05	3.8E-05	3.8E-05	3.5E-05	3.4E-05
NNW	9.1E-05	7.9E-05*	6.9E-05	6.7E-05	6.6E-05	6.0E-05	5.8E-05
NW	3.9E-05	3.3E-05	2.8E-05*	2.7E-05	2.6E-05	2.5E-05	2.4E-05
WNW	3.3E-05	2.6E-05	2.1E-05	2.0E-05	1.9E-05*	1.7E-05	1.7E-05
W	3.1E-05	2.5E-05	1.9E-05	1.8E-05	1.8E-05	1.6E-05	1.5E-05
WSW	3.4E-05	2.8E-05	2.2E-05	2.1E-05	2.1E-05	1.8E-05	1.8E-05
SW	5.4E-05	4.5E-05	3.8E-05	3.7E-05	3.6E-05	3.4E-05	3.3E-05
SSW	2.7E-05	2.4E-05	2.3E-05	2.3E-05	2.3E-05	2.4E-05	2.4E-05
S	2.3E-05	2.0E-05	1.8E-05	1.8E-05	1.8E-05	1.8E-05	1.8E-05
SSE	2.5E-05	2.2E-05	2.0E-05	2.0E-05	2.0E-05	2.0E-05	2.0E-05
SE	4.4E-05	4.1E-05	3.8E-05	3.8E-05	3.8E-05	3.9E-05	3.9E-05
ESE	1.0E-04	8.4E-05	6.8E-05	6.4E-05	6.3E-05	5.3E-05	5.1E-05
E	7.0E-05	6.0E-05	5.0E-05	4.8E-05	4.7E-05	4.1E-05	4.0E-05
ENE	2.5E-05	2.2E-05	2.0E-05	2.0E-05	2.0E-05	2.0E-05	2.0E-05
NE	2.1E-05	2.0E-05	1.8E-05	1.8E-05	1.8E-05	1.7E-05	1.7E-05
NNE	2.0E-05	1.9E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05	1.7E-05

	Distance (m)			
Direction	1050	1300	1650	2550
N	3.3E-05	2.9E-05	2.5E-05	1.8E-05
NNW	5.7E-05	4.9E-05	4.0E-05	2.7E-05
NW	2.4E-05	2.1E-05	1.9E-05	1.4E-05
WNW	1.6E-05	1.4E-05	1.3E-05	1.0E-05
W	1.5E-05	1.3E-05	1.2E-05	9.6E-06
WSW	1.7E-05	1.5E-05	1.3E-05	1.0E-05
SW	3.2E-05	2.9E-05	2.4E-05	1.8E-05
SSW	2.4E-05	2.2E-05	2.0E-05	1.5E-05
S	1.8E-05	1.7E-05	1.5E-05	1.3E-05
SSE	2.0E-05	1.9E-05	1.8E-05	1.4E-05
SE	3.8E-05	3.5E-05	3.1E-05	2.3E-05
ESE	4.9E-05	4.1E-05	3.3E-05	2.2E-05
E	3.8E-05	3.3E-05	2.7E-05	1.8E-05
ENE	1.9E-05	1.8E-05	1.6E-05	1.3E-05
NE	1.7E-05	1.6E-05	1.4E-05	1.2E-05
NNE	1.6E-05	1.5E-05	1.4E-05	1.1E-05

Underlined values indicate the location of the nearest receptor in the designated direction.

*Business locations

Nov 2, 2011 03:18 pmm

SUMMARY
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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	1.6E-11	1.4E-11	1.2E-11	1.2E-11	1.2E-11	1.1E-11	1.1E-11
NNW	2.6E-11	2.3E-11	2.0E-11	1.9E-11	1.9E-11	1.7E-11	1.7E-11
NW	1.2E-11	1.1E-11	9.1E-12	8.9E-12	8.8E-12	8.3E-12	8.1E-12
WNW	1.1E-11	8.9E-12	7.4E-12	7.1E-12	6.9E-12	6.3E-12	6.2E-12
W	1.0E-11	8.4E-12	7.0E-12	6.7E-12	6.5E-12	5.9E-12	5.8E-12
WSW	1.1E-11	9.3E-12	7.7E-12	7.4E-12	7.3E-12	6.5E-12	6.4E-12
SW	1.7E-11	1.4E-11	1.2E-11	1.2E-11	1.1E-11	1.1E-11	1.1E-11
SSW	9.2E-12	8.2E-12	7.7E-12	7.7E-12	7.7E-12	7.9E-12	7.9E-12
S	8.2E-12	7.2E-12	6.5E-12	6.4E-12	6.3E-12	6.3E-12	6.3E-12
SSE	8.6E-12	7.6E-12	7.0E-12	6.9E-12	6.9E-12	6.9E-12	6.9E-12
SE	1.4E-11	1.3E-11	1.2E-11	1.2E-11	1.2E-11	1.2E-11	1.2E-11
ESE	2.8E-11	2.4E-11	2.0E-11	1.9E-11	1.8E-11	1.6E-11	1.5E-11
E	2.0E-11	1.7E-11	1.5E-11	1.4E-11	1.4E-11	1.2E-11	1.2E-11
ENE	8.4E-12	7.6E-12	7.0E-12	6.9E-12	6.9E-12	6.8E-12	6.7E-12
NE	7.4E-12	6.8E-12	6.3E-12	6.2E-12	6.2E-12	6.1E-12	6.0E-12
NNE	7.1E-12	6.6E-12	6.2E-12	6.1E-12	6.1E-12	6.0E-12	6.0E-12

	Distance (m)			
Direction	1050	1300	1650	2550
N	1.0E-11	9.3E-12	8.2E-12	6.4E-12
NNW	1.7E-11	1.5E-11	1.2E-11	8.8E-12
NW	8.0E-12	7.4E-12	6.6E-12	5.4E-12
WNW	6.1E-12	5.6E-12	5.1E-12	4.4E-12
W	5.7E-12	5.2E-12	4.8E-12	4.2E-12
WSW	6.3E-12	5.7E-12	5.2E-12	4.4E-12
SW	1.0E-11	9.3E-12	8.2E-12	6.4E-12
SSW	7.9E-12	7.5E-12	6.9E-12	5.7E-12
S	6.2E-12	6.0E-12	5.7E-12	5.0E-12
SSE	6.9E-12	6.7E-12	6.3E-12	5.3E-12
SE	1.2E-11	1.1E-11	9.8E-12	7.6E-12
ESE	1.5E-11	1.2E-11	1.0E-11	7.5E-12
E	1.2E-11	1.0E-11	8.7E-12	6.5E-12
ENE	6.7E-12	6.3E-12	5.9E-12	5.0E-12
NE	6.0E-12	5.7E-12	5.4E-12	4.6E-12
NNE	5.9E-12	5.6E-12	5.3E-12	4.6E-12

ATTACHMENT C

CAP88-PC OUTPUT

SPRU Diffuse Sources

Synopsis

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

S Y N O P S I S R E P O R T

Non-Radon Individual Assessment
Nov 2, 2011 03:29 pmm

Facility: SPRU DP
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Diffuse Soil Emission
Source Type: Area
Emission Year: 2009

Comments: revised 2009 compliance report

Effective Dose Equivalent (mrem/year)
3.22E-09

At This Location: 450 Meters Southwest
Dataset Name: 2010 Diffuse EDE
Dataset Date: 11/2/2011 3:27:00 PM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL200

Nov 2, 2011 03:29 pmm SYNOPSIS
Page 1

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters Southwest
Lifetime Fatal Cancer Risk: 2.38E-15

Nov 2, 2011 03:29 pmm SYNOPSIS
Page 2

RADIONUCLIDE EMISSIONS DURING THE YEAR 2009

Nuclide	Type	Size	Source #1 Ci/y	TOTAL Ci/y
Cs-137	F	1	2.1E-09	2.1E-09
Ba-137m	M	1	2.1E-09	2.1E-09
Pu-239	M	1	2.7E-11	2.7E-11
Pu-241	M	1	1.5E-11	1.5E-11
Am-241	M	1	3.4E-12	3.4E-12
Sr-90	M	1	4.3E-09	4.3E-09
Y-90	M	1	4.3E-09	4.3E-09

SITE INFORMATION

Temperature: 9 degrees C
Precipitation: 97 cm/y
Humidity: 8 g/cu m
Mixing Height: 1000 m

User specified location of max exposed individual.
(ILOC, JLOC): 7, 1

SOURCE INFORMATION

Source Number: 1

Source Height (m): 0.00
Area (sq m): 420.00

Plume Rise Momentum (m/s): 0.00
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.700	0.400	0.440
Fraction From Assessment Area:	0.300	0.600	0.560
Fraction Imported:	0.000	0.000	0.000

Food Arrays were not generated for this run.
Default Values used.

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

450 550 700 750 775 950 1000
1050 1300 1650 2550

ATTACHMENT D

CAP88-PC OUTPUT

SPRU Diffuse Sources
Dose & Risk Equivalent

Summary

C A P 8 8 - P C
Version 3.0
Clean Air Act Assessment Package - 1988

D O S E A N D R I S K E Q U I V A L E N T S U M M A R I E S
Non-Radon Individual Assessment
Nov 2, 2011 03:29 pmm

Facility: SPRU DP
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Diffuse Soil Emission
Source Type: Area
Emission Year: 2009

Comments: revised 2009 compliance report

Dataset Name: 2010 Diffuse EDE
Dataset Date: 11/2/2011 3:27:00 PM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2009.WND

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	0.00E+00
INHALATION	3.22E-09
AIR IMMERSION	4.32E-12
GROUND SURFACE	0.00E+00
INTERNAL	3.22E-09
EXTERNAL	4.32E-12
TOTAL	3.22E-09

Nov 2, 2011 03:29 pmm

SUMMARY
Page 2

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
Cs-137	1.87E-10
Ba-137m	4.02E-12
Pu-239	0.00E+00
U-235	0.00E+00
Th-231	0.00E+00
Pu-241	0.00E+00
Am-241	0.00E+00
Np-237	0.00E+00
Pa-233	0.00E+00
U-233	0.00E+00
Th-229	0.00E+00
U-237	0.00E+00
Sr-90	2.92E-09
Y-90	1.14E-10
TOTAL	3.22E-09

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
Esophagu	2.23E-18
Stomach	8.79E-18
Colon	1.44E-16
Liver	3.26E-18
LUNG	1.82E-15
Bone	1.45E-17
Skin	1.79E-19
Breast	7.08E-18
Ovary	2.85E-18
Bladder	6.26E-18
Kidneys	1.06E-18
Thyroid	5.39E-19
Leukemia	3.43E-16
Residual	2.72E-17
Total	2.38E-15
TOTAL	4.76E-15

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	0.00E+00
INHALATION	2.38E-15
AIR IMMERSION	2.25E-18
GROUND SURFACE	0.00E+00
INTERNAL	2.38E-15
EXTERNAL	2.25E-18
TOTAL	2.38E-15

Nov 2, 2011 03:29 pmm

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
Cs-137	8.77E-17
Ba-137m	2.20E-18
Pu-239	0.00E+00
U-235	0.00E+00
Th-231	0.00E+00
Pu-241	0.00E+00
Am-241	0.00E+00
Np-237	0.00E+00
Pa-233	0.00E+00
U-233	0.00E+00
Th-229	0.00E+00
U-237	0.00E+00
Sr-90	2.17E-15
Y-90	1.21E-16
TOTAL	2.38E-15

Nov 2, 2011 03:29 pmm

SUMMARY
Page 5

INDIVIDUAL EFFECTIVE DOSE EQUIVALENT RATE (mrem/y)
(A11 Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	3.4E-09	2.3E-09	1.4E-09	1.2E-09	1.2E-09	7.7E-10	6.9E-10
NNW	5.7E-09	3.8E-09*	2.4E-09	2.1E-09	1.9E-09	1.3E-09	1.2E-09
NW	2.3E-09	1.5E-09	9.5E-10*	8.3E-10	7.8E-10	5.2E-10	4.6E-10
WNW	1.2E-09	7.8E-10	4.8E-10	4.1E-10	3.9E-10*	2.6E-10	2.3E-10
W	9.9E-10	6.6E-10	4.0E-10	3.5E-10	3.3E-10	2.2E-10	2.0E-10
WSW	1.2E-09	8.2E-10	5.0E-10	4.4E-10	4.1E-10	2.7E-10	2.4E-10
SW	3.2E-09	2.2E-09	1.3E-09	1.2E-09	1.1E-09	7.2E-10	6.5E-10
SSW	2.7E-09	1.8E-09	1.1E-09	9.8E-10	9.2E-10	6.1E-10	5.5E-10
S	2.1E-09	1.4E-09	8.5E-10	7.4E-10	6.9E-10	4.6E-10	4.1E-10
SSE	2.5E-09	1.7E-09	1.0E-09	9.0E-10	8.4E-10	5.6E-10	5.0E-10
SE	4.9E-09	3.3E-09	2.0E-09	1.8E-09	1.6E-09	1.1E-09	9.8E-10
ESE	4.1E-09	2.7E-09	1.7E-09	1.5E-09	1.4E-09	9.4E-10	8.5E-10
E	3.2E-09	2.2E-09	1.4E-09	1.2E-09	1.1E-09	7.5E-10	6.8E-10
ENE	2.0E-09	1.3E-09	8.2E-10	7.1E-10	6.7E-10	4.4E-10	4.0E-10
NE	1.6E-09	1.1E-09	6.7E-10	5.9E-10	5.5E-10	3.6E-10	3.3E-10
NNE	1.5E-09	1.0E-09	6.4E-10	5.5E-10	5.2E-10	3.4E-10	3.1E-10

	Distance (m)			
Direction	1050	1300	1650	2550
N	6.3E-10	4.3E-10	2.8E-10	1.3E-10
NNW	1.1E-09	7.4E-10	4.8E-10	2.2E-10
NW	4.2E-10	2.9E-10	1.9E-10	8.5E-11
WNW	2.1E-10	1.4E-10	9.2E-11	4.1E-11
W	1.8E-10	1.2E-10	7.8E-11	3.5E-11
WSW	2.2E-10	1.5E-10	9.8E-11	4.4E-11
SW	6.0E-10	4.1E-10	2.7E-10	1.2E-10
SSW	5.0E-10	3.4E-10	2.2E-10	1.0E-10
S	3.8E-10	2.6E-10	1.7E-10	7.5E-11
SSE	4.6E-10	3.1E-10	2.0E-10	9.2E-11
SE	9.0E-10	6.1E-10	4.0E-10	1.8E-10
ESE	7.8E-10	5.4E-10	3.5E-10	1.6E-10
E	6.2E-10	4.3E-10	2.8E-10	1.3E-10
ENE	3.6E-10	2.5E-10	1.6E-10	7.4E-11
NE	3.0E-10	2.1E-10	1.3E-10	6.1E-11
NNE	2.8E-10	1.9E-10	1.3E-10	5.7E-11

Underlined values indicate the location of the nearest receptor in the designated direction.

*Business locations

Nov 2, 2011 03:29 pmm

SUMMARY
Page 6

INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	450	550	700	750	775	950	1000
N	2.5E-15	1.7E-15	1.0E-15	9.1E-16	8.5E-16	5.7E-16	5.1E-16
NNW	4.2E-15	2.8E-15	1.8E-15	1.5E-15	1.4E-15	9.6E-16	8.6E-16
NW	1.7E-15	1.1E-15	7.0E-16	6.1E-16	5.7E-16	3.8E-16	3.4E-16
WNW	8.6E-16	5.7E-16	3.5E-16	3.1E-16	2.9E-16	1.9E-16	1.7E-16
W	7.3E-16	4.9E-16	3.0E-16	2.6E-16	2.4E-16	1.6E-16	1.5E-16
WSW	9.1E-16	6.1E-16	3.7E-16	3.2E-16	3.0E-16	2.0E-16	1.8E-16
SW	2.4E-15	1.6E-15	9.9E-16	8.6E-16	8.1E-16	5.4E-16	4.8E-16
SSW	2.0E-15	1.4E-15	8.4E-16	7.3E-16	6.8E-16	4.5E-16	4.1E-16
S	1.5E-15	1.0E-15	6.3E-16	5.5E-16	5.1E-16	3.4E-16	3.0E-16
SSE	1.9E-15	1.2E-15	7.7E-16	6.7E-16	6.2E-16	4.1E-16	3.7E-16
SE	3.6E-15	2.4E-15	1.5E-15	1.3E-15	1.2E-15	8.1E-16	7.3E-16
ESE	3.0E-15	2.0E-15	1.3E-15	1.1E-15	1.0E-15	7.0E-16	6.3E-16
E	2.4E-15	1.6E-15	1.0E-15	8.8E-16	8.3E-16	5.5E-16	5.0E-16
ENE	1.5E-15	9.8E-16	6.0E-16	5.3E-16	4.9E-16	3.3E-16	2.9E-16
NE	1.2E-15	8.1E-16	5.0E-16	4.3E-16	4.1E-16	2.7E-16	2.4E-16
NNE	1.1E-15	7.6E-16	4.7E-16	4.1E-16	3.8E-16	2.5E-16	2.3E-16

	Distance (m)			
Direction	1050	1300	1650	2550
N	4.7E-16	3.2E-16	2.1E-16	9.6E-17
NNW	7.9E-16	5.4E-16	3.6E-16	1.6E-16
NW	3.1E-16	2.1E-16	1.4E-16	6.3E-17
WNW	1.6E-16	1.1E-16	6.8E-17	3.1E-17
W	1.3E-16	9.0E-17	5.8E-17	2.6E-17
WSW	1.7E-16	1.1E-16	7.2E-17	3.3E-17
SW	4.4E-16	3.0E-16	2.0E-16	9.0E-17
SSW	3.7E-16	2.5E-16	1.7E-16	7.6E-17
S	2.8E-16	1.9E-16	1.2E-16	5.5E-17
SSE	3.4E-16	2.3E-16	1.5E-16	6.8E-17
SE	6.6E-16	4.5E-16	3.0E-16	1.4E-16
ESE	5.8E-16	4.0E-16	2.6E-16	1.2E-16
E	4.6E-16	3.2E-16	2.1E-16	9.6E-17
ENE	2.7E-16	1.8E-16	1.2E-16	5.5E-17
NE	2.2E-16	1.5E-16	9.9E-17	4.5E-17
NNE	2.1E-16	1.4E-16	9.3E-17	4.3E-17

ATTACHMENT E

CAP88-PC OUTPUT

SPRU

Weather Data
For Point and Diffuse Sources
for
2009

C A P 8 8 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

W E A T H E R D A T A

Non-Radon Individual Assessment
Oct 6, 2011 03:11 pm

Facility: Separations Process Research Unit
Address: 2425
River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Area
Source Type: Area
Emission Year: 2009

Comments: Run 2009 Dose Assessment
For Diffuse Source

Dataset Name: 2009 Diffuse
Dataset Date: 10/6/2011 3:01:00 PM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2009.WND

Oct 6, 2011 03:11 pm

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class							
Dir	A	B	C	D	E	F	G	Wind Freq
N	1.025	1.742	3.114	2.066	1.115	0.825	0.000	0.066
NNW	1.207	2.433	3.868	2.907	1.343	0.984	0.000	0.147
NW	0.969	1.424	1.312	5.367	0.996	0.842	0.000	0.048
WNW	0.873	1.260	1.892	0.772	1.075	0.810	0.000	0.034
W	0.805	0.827	0.846	0.772	0.772	0.772	0.000	0.026
WSW	0.784	0.867	0.814	0.772	0.852	0.772	0.000	0.030
SW	0.990	1.970	1.655	2.630	1.623	0.921	0.000	0.076
SSW	0.873	3.734	4.373	4.373	1.867	0.890	0.000	0.040
S	0.790	2.572	0.000	0.000	2.572	0.775	0.000	0.028
SSE	0.810	2.968	0.000	4.373	1.187	0.789	0.000	0.033
SE	0.925	2.532	4.461	3.303	1.155	0.865	0.000	0.072
ESE	1.388	3.107	4.301	4.098	1.630	0.939	0.000	0.190
E	1.367	2.939	4.361	4.130	1.779	0.941	0.000	0.128
ENE	1.094	2.422	4.328	3.633	1.560	0.836	0.000	0.037
NE	1.123	1.379	2.974	1.469	1.103	0.801	0.000	0.024
NNE	0.952	1.823	4.373	1.377	0.966	0.809	0.000	0.022

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	1.408	2.487	4.280	3.196	1.564	0.938	0.000
NNW	1.700	3.029	4.395	3.566	1.933	1.326	0.000
NW	1.294	2.034	2.572	5.659	1.351	0.986	0.000
WNW	1.070	1.833	3.318	0.772	1.498	0.895	0.000
W	0.878	0.945	0.998	0.772	0.772	0.772	0.000
WSW	0.811	1.054	0.905	0.772	1.014	0.772	0.000
SW	1.338	2.692	2.415	2.948	2.121	1.188	0.000
SSW	1.070	3.933	4.373	4.373	2.572	1.114	0.000
S	0.831	2.572	0.000	0.000	2.572	0.783	0.000
SSE	0.893	3.155	0.000	4.373	1.672	0.829	0.000
SE	1.198	3.177	4.511	3.991	1.794	1.049	0.000
ESE	1.914	3.421	4.577	4.723	2.126	1.230	0.000
E	1.892	3.334	4.674	4.921	2.228	1.235	0.000
ENE	1.530	3.266	4.507	4.041	2.072	0.969	0.000
NE	1.577	2.464	4.588	2.088	1.544	0.867	0.000
NNE	1.258	2.572	4.373	2.270	1.289	0.890	0.000

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	Pasquill Stability Class						
Dir	A	B	C	D	E	F	G
N	0.1479	0.1095	0.0608	0.1756	0.1305	0.3756	0.0000
NNW	0.2263	0.1197	0.0614	0.1563	0.1205	0.3157	0.0000
NW	0.4988	0.0404	0.0096	0.0046	0.0666	0.3801	0.0000
WNW	0.6320	0.0743	0.0269	0.0033	0.0169	0.2466	0.0000
W	0.5243	0.1366	0.0706	0.0042	0.0089	0.2554	0.0000
WSW	0.5328	0.0734	0.0501	0.0233	0.0578	0.2625	0.0000
SW	0.4559	0.0687	0.0165	0.0433	0.0538	0.3617	0.0000
SSW	0.3144	0.0114	0.0058	0.0028	0.0141	0.6515	0.0000
S	0.3656	0.0120	0.0000	0.0000	0.0039	0.6186	0.0000
SSE	0.3127	0.0103	0.0000	0.0070	0.0067	0.6633	0.0000
SE	0.2153	0.0191	0.0286	0.0654	0.0701	0.6014	0.0000
ESE	0.0873	0.1060	0.1621	0.4392	0.0656	0.1398	0.0000
E	0.0804	0.1037	0.1456	0.3906	0.1028	0.1769	0.0000
ENE	0.1739	0.0791	0.0913	0.1557	0.0548	0.4452	0.0000
NE	0.1793	0.0756	0.0376	0.0706	0.0991	0.5378	0.0000
NNE	0.1886	0.0711	0.0255	0.0612	0.1073	0.5463	0.0000
TOTAL	0.2429	0.0824	0.0754	0.1860	0.0744	0.3389	0.0000

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 9.1 degrees C
281.76 K
Precipitation: 97 cm/y
Humidity: 8.0 g/cu m
Lid Height: 1000 meters
Surface Roughness Length: 0.010 meters
Height Of Wind Measurements: 10.0 meters
Average Wind Speed: 2.203 m/s

Vertical Temperature Gradients:
STABILITY E 0.073 k/m
STABILITY F 0.109 k/m
STABILITY G 0.146 k/m