**Department of Energy**
Naval Reactors Laboratory Field Office
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NRLFO:AMO-S:ESH:11-123
June 29, 2011

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 REPORT OF RADIONUCLIDE EMISSIONS FOR CALENDAR YEAR 2010**

Enclosed pursuant to 40 CFR 61.94 is the Calendar Year 2010 Radionuclide National Emissions Standards for Hazardous Air Pollutants Report for the Department of Energy (DOE) - Knolls Site in Niskayuna, NY.

In previous years, the Naval Reactors Laboratory Field Office issued annual reports of Knolls Atomic Power Laboratory (KAPL) operations at the DOE - Knolls Site; DOE - Office of Environmental Management issued a separate report for the Separations Process Research Unit (SPRU) Disposition Project and Land Areas at the DOE - Knolls Site. The Environmental Protection Agency, Region 2 has requested all activities at the DOE - Knolls Site be included in a single report. This report includes all activities at the DOE - Knolls Site. DOE - Kesselring Site information is being submitted in a separate report.

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 2010**

**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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## 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$^{o}$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 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 within the 170 acres of land belonging to DOE Knolls Site. The SPRU LA is engaged in remediation of soils contaminated during the 1950s as part of the development of chemical separation processes for the U.S. Department of Energy's (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. The SPRU DP is engaged in remediation of buildings and lands contaminated during the 1950's during development of chemical separation processes for the Department of Energy'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*, which was prepared for the DOE's SPRU Project Office by Environmental Resource Group, LLC (ERG 2006).

**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 2010 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 (ERG 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 2010 consisted of operating radioactive water processing systems, maintenance, removal of legacy radioactive materials, remediation of hazardous materials, and preparations for demolition of the buildings. Removal of asbestos, draining pipes and tanks, and similar radioactive work efforts were performed with appropriate containment or ventilation. Open air demolition of the facility was initiated on September 27, 2010. Open air demolition was terminated on September 30, 2010 following an unplanned release on September 29, 2010. This unplanned release occurred after radioactive components were mistakenly size-reduced in open air. Following the termination of open air demolition, SPRU DP work scope transitioned to maintenance of contamination controls, shipment of hazardous wastes, water processing, and preparations for installation of enclosures and resumption of Decontamination and Demolition (D&D) work.

Excavation and stockpiling of soil was also performed on the facility site in early 2010. Radioactive materials related to the SPRU DP activities were not detected in samples of the soil that was excavated in 2010.

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. Estimated emissions from unmonitored emission points were based on annual confirmatory measurements (e.g., radioactive material usage surveys). The KAPL point source emission data is shown in Table 1.

**Table 1 - KAPL Point Source Air Emission Data - 2010**

| 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[5] | HEPA Filter[6] | 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 C6 | HEPA Filter | 99.95 | 400 | 600 | 800 | 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 [7] (4 vents) | Static HEPA Filter | 99.95 | 425 | 550 | 800 | U-234, Sr-90, Cs-137 |
| *Building E1/G1 Basement[7] | None | - | 400 | 550 | 825 | U-234, Sr-90, Cs-137 |
| *Building G1 Air Sample Pump Exhaust[7] | Note 8 | 99.95 | 400 | 550 | 825 | U-234, Sr-90, Cs-137 |
| *Building A3[7] | None | - | 300 | 650 | 900 | U-234 |

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 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 are listed.

(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) Building E4 is the only emission point that has the potential to discharge radionuclides into the air in quantities such that the effective dose equivalent could be ≥ 0.1 mrem/year. The emission point is monitored with an ANSI/HPS N13.1-1999 compliant system.

(6) 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.

(7) The estimated emissions from the annual confirmatory measurements are included in the radionuclide total annual emissions in Table 2 - KAPL Air Emission Data. The asterisk (*) indicates that an emission point is not monitored.

(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 DOP or equivalent particles.

**Table 2 - KAPL Air Emission Data - 2010**

| Radionuclide | Annual Quantity Ci[(1)] |
|---|---|
| H-3 | 1.44 E-07 |
| Kr-85 | 2.75 E-02 |
| Co-60 | 2.58 E-08 |
| Sr-90 | 2.97 E-06 |
| Y-90 | 2.97 E-06 |
| Cs-137 | 2.97 E-06 |
| U-234 | 6.15 E-07 |
| U-235 | 1.03 E-08 |
| U-236 | 1.91 E-09 |
| U-238 | 6.64 E-11 |
| Pu-238 | 2.08 E-08 |

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

Included in the above emissions table is an estimated contribution from SPRU DP's emission from the E1/G1 hot tunnel work which was exhausted into the E1/G1 basement areas and is exhausted to the environment through the E1/G1 Basement Ventilation System. The KAPL estimated emissions from the E1/G1 Basement Ventilation System were as follows:

**Table 2A - E1/G1 Basement Ventilation System Estimated Air Emissions – 2010**

| Radionuclide | Estimated Release Ci |
|---|---|
| H-3 | 1.44 E-07 |
| Co-60 | 2.00 E-11 |
| Sr-90 | 1.00 E-07 |
| Y-90 | 1.00 E-07 |
| Cs-137 | 1.00 E-07 |
| U-234 | 5.71 E-11 |
| U-235 | 2.56 E-12 |
| U-236 | 2.33 E-15 |
| U-238 | 5.48 E-11 |

The estimated contribution from the SPRU DP hot tunnel work to the above source term based upon KAPL fixed filter air sampling data in the E1 and G1 basement areas is Sr-90, 1E-07 Ci; Y-90, 1E-07 Ci; and Cs-137, 1E-07 Ci. The remaining emissions were based upon radioactive material usage surveys for radioactive liquids that have the potential to be vented into the G1 basement area via an inceptor tank. Prior to commencing any future work in the E1/G1 hot tunnels, SPRU DP will establish a separate emission point rather than discharging to the E1/G1 basement.

**SPRU LA**

There were no point sources for the SPRU-LA during 2010.

**SPRU DP**

The point source release data from the H2 stack and G2 vent were obtained from continuous particulate air samplers 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 prior to shutting down the fans and releases from portable ventilation units that operated after the primary ventilation was secured. The exhaust fans and air particulate samplers were operated continuously. SPRU DP staff performed daily surveillances to verify operability. The exhaust flowrate instruments were not calibrated during CY 2010, as the permanent systems were taken out of service during the year. Process knowledge of the system operating parameters was used to determine the exhaust flow rates. The HEPA filters that were installed at the time of turnover were not replaced or tested in place during 2010 as the systems were taken out of service during the year. 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. 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 2010.

The G2 vent exhaust was shut down on April 6, 2010. A portable HEPA exhaust system provided ventilation for work in the G2 process cells until August 4, 2010. The H2 stack exhaust was shut down on August 25, 2010. Portable HEPA ventilation systems were used to support sludge processing and/or to maintain engineering control of ventilation from July 26, 2010 until December 31, 2010. By procedure, HEPA units are tested in-place to verify 99.95% efficiency prior to initial use and annually. Procedures stipulate that the HEPA filters are not used if efficiency testing expiration date has been reached. The following table lists the point source emissions relative to offsite receptors and types of radionuclide measurements.

**Table 3 - SPRU DP Point Source Air Emission Data – 2010**

| 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 |
| H2 Sludge Processing | HEPA | 99.95 | 550 | 425 | 775 | Gross alpha, beta |
| Building G2 SP-11 | HEPA | 99.95 | 475 | 475 | 800 | 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. Filtration units are tested in-place after installation. In-place testing requires a minimum collection efficiency of 99.95% for 0.7 micron aerosol particles.
2. The nearest farm producing meat and/or milk is about 2000 meters from the center of the KAPL site, and the nearest school is about 1700 meters away. All distances to receptors are measured from the center of the KAPL site. The location of the nearest receptor may or may not correspond to the location of the MEOSI, depending on dispersion and occupancy factors. 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 are provided in Table 4.

The discharges of the portable ventilation units were monitored with ambient air samples near the point of discharge. The air sample pumps and filters that monitored (via ambient air sampling) the discharges of portable units were equivalent to the equipment used as the stack samplers. The discharge flow rates of the portable HEPA units were based on manufacturer's data. The ventilation run times varied according to the nature of the work. Air samplers were operated while the portable HEPA units were operating.

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 were applied to the net gross count results to detemine the radionuclide concentrations.

**Table 4 - SPRU DP Point Source Emissions Details – 2010**

| Radionuclide | G2 Vent, (Ci) | G2 SP-11, (Ci) | H2 Stack, (Ci) | H2 / Sludge Process Vent, (Ci) | Annual Quantity, (Ci) |
|---|---|---|---|---|---|
| Am-241[(1)] | 1.6E-09 | 3.9E-09 | 6.4E-08 | 1.7E-10 | 7.0E-08 |
| Cs-137[(2)] | 7.5E-08 | 2.3E-07 | 1.3E-06 | 5.6E-09 | 1.7E-06 |
| Sr-90[(2)] | 1.4E-08 | 4.2E-08 | 2.5E-07 | 2.1E-09 | 3.1E-07 |
| Pu-239[(1)] | 1.0E-08 | 2.4E-08 | 4.0E-07 | 1.5E-09 | 4.3E-07 |

Notes for SPRU DP Point Source Emissions Details Table 4:

1. Scaled from gross alpha according to radionuclide ratios reported in laboratory analyses of characterization samples. The average Pu-241 concentration is 54% of the Pu-239 concentration. The annual emission of Pu-241 is 2.3E-07 Ci. 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 2010, the majority of the contaminated soil areas were under the cognizance of SPRU remediation project and therefore emissions associated with these areas are not evaluated in this section of the report. The remaining areas with potential soil contamination are either paved over or are covered with vegetation or clean soil or fill 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.

Evaluation of the Potential Emissions from the Decontamination of the KAPL Site Diffuse Source, due to the September 29, 2010 SPRU Contamination Event

On September 29, 2010, a SPRU DP Site event resulted in airborne radiological contamination being spread to KAPL property. The majority of this contamination on the KAPL Site was

cleaned up during October and November 2010. The contamination was spread over an area of approximately 9500 $m^2$. Thorough surveys were taken to determine the level and the extent of the contamination on the KAPL Site. The contamination was not distributed uniformly over the area of concern and can best be characterized as spotty. These extensive survey data and results were used as the basis of the evaluation of the contamination spread as a diffuse potential source of airborne radionuclides. The contaminated area was divided into six zones. Using the results where contamination was actually detected, the average contamination level for each zone was determined. The isotopic distribution of the contamination was determined by radiochemistry analysis. The total isotopic content for each zone was determined by multiplying the average surface contamination level by the area of the zone and then by 0.1, thus, conservatively assuming that 10% of the area was uniformly contaminated (this accounts for the contamination being spotty and not totally uniform over the entire zone). The isotopic contents for the six zones were then summed to obtain the total overall isotopic content for the entire contaminated area. The potential airborne release for the decontamination operation was then calculated by applying the 40 CFR 61 Appendix D particulate release factor to each radionuclide total summed activity. The results are as follows:

**Table 5 - KAPL Diffuse Source Term**

| Radionuclide | Diffuse Source Term (Ci) |
|---|---|
| Sr-90/Y-90 | 8.60E-07 |
| Cs-137 | 7.78E-09 |
| Am-241 | 3.22E-09 |
| Pu-238 | 3.22E-10 |
| Pu-239 | 1.30E-08 |
| Pu-240 | 3.22E-09 |
| Pu-241 | 6.53E-09 |
| Pu-242 | 3.22E-13 |

Using the above as input to CAP88-PC Version 3.0 results in an annual dose of 3.34E-05 mrem to the maximally exposed off-site individual located at a residence in the south-southwest sector at a distance of 450 meters. Five environmental air samplers located immediately adjacent to the contaminated area did not detect any elevated levels of radioactivity during the decontamination of the affected areas.

**SPRU LA**

The generation of airborne radioactive material occurs from the excavation and subsequent packaging for disposal of radioactive contaminated soils. Approximately 1,405 $yd^3$ (37,935 $ft^3$) of material from the Lower Level and 7,914 $yd^3$ (213,678 $ft^3$) from the North Field were excavated, stockpiled, and packaged for disposal during 2010. The volume of contaminated soil excavated and stockpiled in 2010 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 DOE Knolls Site.

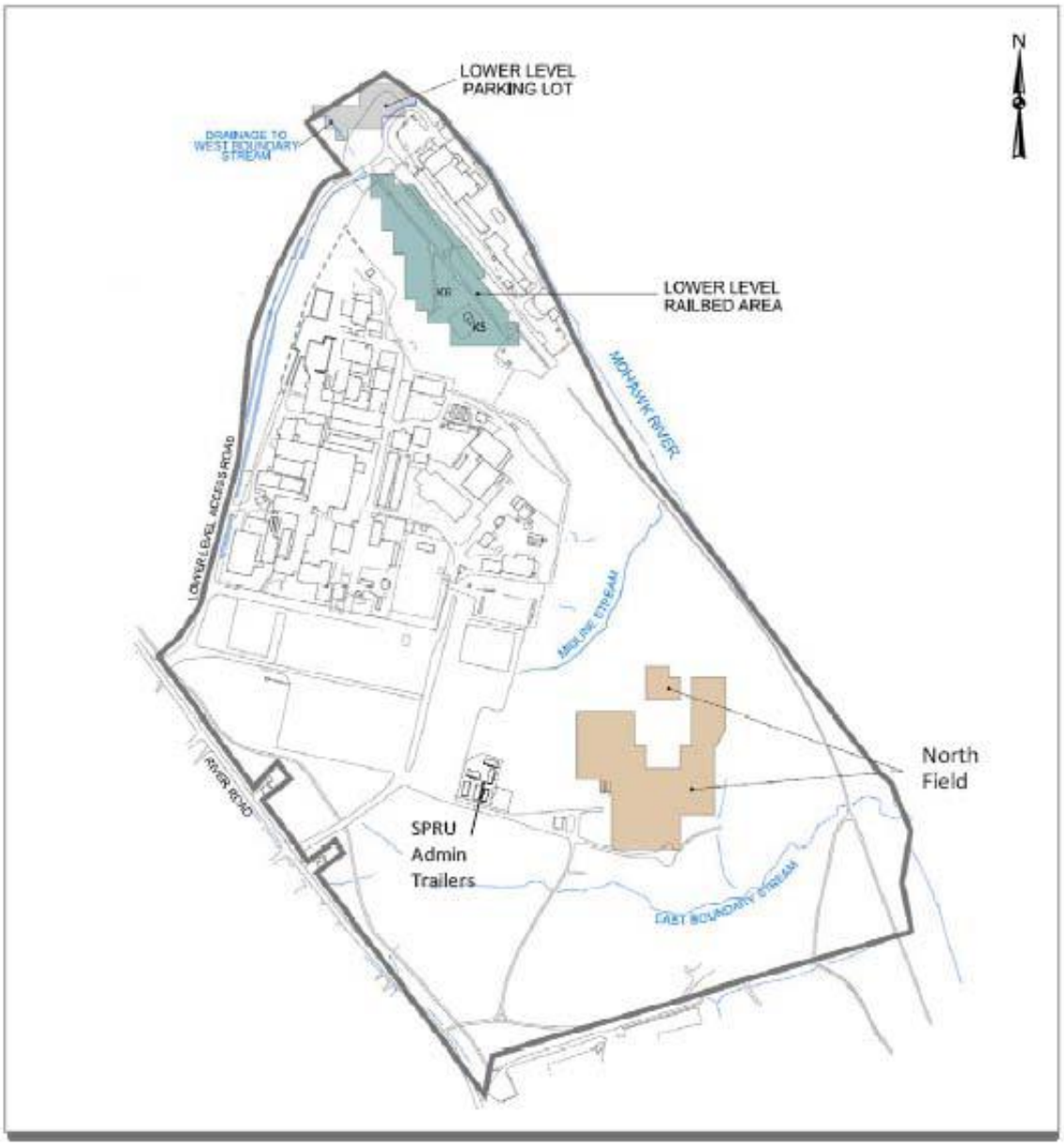


**Figure 1 – SPRU LA Lower Level and North Field Excavation Areas**

The radionuclides identified in Table 6 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) and broad energy germanium (BEGe) 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 (MDA) 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 2010.

Sr-90, U-234, Pu-238, Pu-239, and Pu-240, Pu-241 and Am-241 concentrations were not provided by the HPGe or BEGe 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 soil activities for 2010 in pCi/g were converted to a release rate of Ci/yr using a soil density of 1.8 g/cm$^3$, a conversion factor of 1 × 10$^{12}$ pCi/Ci, the volume of soil excavated (cm$^3$) during the year, and a 1 × 10$^{-3}$ release fraction from 40 CFR Part 61, Appendix D, "Methods for Estimating Radionuclide Emission," which were applied to determine the Ci/yr release rate for the volume of material excavated. The following equation was used to calculate the radionuclide release rates:

$$R = \frac{Cs \times \rho \times VE \times RF}{CF}$$

*where:*

R = release rate (Ci/yr)
Cs = soil activity (pCi/g)
ρ = soil density (1.8 g/cm$^3$)
VE = volume of soil excavated in 2010 (cm$^3$/yr)
RF = release fraction (1E-3 unitless)
CF = conversion factor (1E12 pCi/Ci).

The radionuclide soil activity and release rates from the Lower Level and North Field are provided in Table 6.

**Table 6- SPRU LA Radionuclide Soil Activity and Release Rates**

| 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 | 3.05E-07 | 0.17 | 1.85E-06 |
| Bi-212 | 0.43 | 8.27E-07 | 0.29 | 3.19E-06 |
| Cs-137 | 0.39 | 7.46E-07 | 3.52 | 3.84E-05 |
| Pb-212 | 0.51 | 9.96E-07 | 0.52 | 5.70E-06 |
| Pb-214 | 0.53 | 1.02E-06 | 0.48 | 5.20E-06 |
| Pu-238 | 0.11 | 2.15E-07 | 0.17 | 1.87E-06 |
| Pu-239 | 0.63 | 1.22E-06 | 2.88 | 3.14E-05 |
| Pu-240 | 0.63 | 1.22E-06 | 2.88 | 3.14E-05 |
| Pu-241 | 2.60 | 5.03E-06 | 2.50 | 2.72E-05 |
| Sr-90 | 1.47 | 2.84E-06 | 0.85 | 9.26E-06 |
| Tl-208 | 0.21 | 4.08E-07 | 0.21 | 2.30E-06 |
| U-234 | 2.09 | 4.04E-06 | 2.29 | 2.49E-05 |
| U-235 | 0.11 | 2.12E-07 | 0.16 | 1.70E-06 |
| U-238 | 0.21 | 4.04E-07 | 0.30 | 3.23E-06 |

**SPRU LA Summary of Emissions**

All diffuse (non-point) emission quantities were determined using process knowledge and 40 CFR 61 Appendix D. The Ba-137m and Y-90 decay products of Cs-137 and Sr-90 are assumed to be present in full equilibrium. There were no construction or facility modification activities that affect 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 open air demolition, breathing emissions from buildings and systems, working and transfer losses from tanks, and fugitive emissions associated with maintenance. The diffuse emissions were calculated according to the available radionuclide inventory for each process, utilizing Appendix D or other EPA methods described in the EPA document *Methods for Estimating Fugitive Emissions of Radionuclides from Diffuse Sources at DOE Facilities* (EPA 2004) and process knowledge of physical and chemical processes. Methods and parameters are described in SPRU DP's archives of radiological and environmental engineering calculations. Diffuse emissions are summarized in Table 7.

*Building G2*

The generation of airborne radioactive materials occurs from the resuspension of surface contamination incidental to performing work in the building. Following turnover of the building for demolition, parts of the external walls were removed and the contamination was exposed to the environment. The nature of the work performed by the SPRU DP during 2010 in the buildings consisted of general facility maintenance, removal of legacy radioactive materials,

removal of asbestos and hazardous material, and preparations for demolition of the buildings. When contamination exceeded prescribed levels, fixative was applied to various radiologically contaminated areas on the lower level. Fixative was applied multiple times, primarily to ensure that the application of the fixative cured properly or, if required, to meet demolition criteria if removable contamination persisted following initial application. The diffuse emissions are calculated for the period of time after the building ventilation was shut down.

Loose contamination levels were conservatively calculated (i.e., overestimated) based on bounding estimates of the surfaces contamination levels. Building breathing losses were also evaluated.

*Building H2*

The generation of airborne radioactive materials occurs from the resuspension of surface contamination incidental to performing work in the building. The work performed by the SPRU DP during 2010 that consisted of operating the groundwater treatment system, general facility maintenance, removal of legacy radioactive materials, removal of asbestos and hazardous material, preparations for demolition of the buildings, and demolition of the above grade portion of H2. The diffuse emissions are calculated for the period of time after the building ventilation was shut down. Building breathing losses were also evaluated.

The above grade portion of H2 was demolished from September 27-29, 2010. The emission from the open air demolition of the structure above the 332' elevation of Building H2 was evaluated by estimating the radioactive material content of nineteen HEPA filters that were installed in Building H2. These HEPA filters were used, prior to demolition, for removal of radioactive particulates in air from the various locations in the building (Hot/Cold Evaporator Rooms, Vent Header, Dryer Cells, etc.) before tying into the building exhaust. The HEPA filters were the sole components that comprise the source term for open air demolition of the 332' elevation structure. The radioactive material inventory was determined from radiation dose rate measurements and factors used to convert dose rate to curies in the filters.

Loose contamination levels for the period after September 29, 2010 were conservatively calculated based on bounding estimates of the surface contamination levels and used to determine release quantities in diffusion modeling.

*Unplanned Release /Debris Pile*

On September 29, 2010, a radioactive contamination event occurred while performing open air demolition of Building H2. The unplanned release is included with other diffuse sources. The event is further discussed in Section IV.

*Sludge Processing*

The installation of a weather protection tent over the roof of the tank vaults was completed in March 2010. The roof of the vaults was then used as a process area and sludge solidification equipment was installed. The sludge was consolidated in Tank 509E and the emptied tanks were cleaned with rinse water sprays. A spill of sludge in the summer of 2010 contaminated an area of the floor inside the tent. Decontamination activities were performed inside the tent and estimated emissions are included in this assessment. Additionally, breathing and working losses (defined below) from waste inside the tanks during periods of non-active ventilation have been included.

*Water*

Fugitive emissions from water transfers occur when water containing radioactivity fills a collection vessel (tank) and contaminated air is displaced ("working losses"). In this process air exits the vessel via a vent or vents. Breathing losses occur when air is displaced outward from the vessel during storage when the air or water inside the vessel warms or when atmospheric pressure changes. Building, storage tank, and water transfer emissions were evaluated by applying conservative concentrations and vapor phase partition factors. Representative water samples were analyzed by an offsite laboratory.

In 2010, 170,000 gallons of hillside sump water were collected and processed. The following H2 basement water transfers occurred: 50,000 gallons were shipped off-site between November 10, 2010 and December 06, 2010; and 50,000 gallons remained in frac tanks on-site as of December 31, 2010. In addition, 10,000 gallons were removed in July 2010 from G2 Room 103 and shipped off-site for disposal in 2011.

*Soil*

The excavation of the soil over the tank farm was completed in early 2010. Samples were collected for laboratory analysis under SPRU DP sample plans TSE-01 and TSE-02. Laboratory analyses of soil samples from 2010 did not indicate the presence of radionuclides from the SPRU process in excess of natural background or analytical detection limits. No source term is therefore provided.

*Waste Shipping*

In 2010, 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 no source term is provided.

**Table 7- SPRU DP Diffuse Emissions by Source – 2010 (Ci)**

| | G2 & H2 | Unplanned Release/ Debris Pile | G2 Water | H2 Water | H2 El 332 Demo | Tank Farm Decon* ** | Tank Farm Sludge* ** | Hillside Drain Water | Total Diffuse Emission*** |
|---|---|---|---|---|---|---|---|---|---|
| Am-241 | 2.5E-12 | 6.3E-06 | 1.4E-09 | 7.1E-09 | 6.8E-10 | 8.4E-10 | 4.0E-09 | 9.7E-09 | 6.3E-06 |
| Cs-137 | 1.0E-09 | 1.9E-05 | 2.8E-06 | 7.1E-07 | 3.4E-08 | 4.6E-08 | 2.2E-07 | 4.9E-07 | 2.3E-05 |
| Sr-90 | 7.5E-10 | 4.2E-04 | 1.4E-06 | 1.1E-06 | 1.6E-08 | 1.7E-08 | 8.2E-08 | 1.2E-06 | 4.2E-04 |
| Pu-239 | 3.7E-12 | 3.9E-05 | 2.8E-09 | 9.9E-09 | 5.8E-09 | 5.7E-09 | 2.7E-08 | 4.9E-09 | 3.9E-05 |

*Pu-239 and Am-241 scaled from gross alpha according to radionuclides reported in laboratory analysis of characterization sample.

**Cs-137 and Sr-90 scaled from gross beta according to radionuclides reported in laboratory analysis of characterizations.

***The annual emission of Pu-241 is 1.8E-05 Ci, which is 45.5% of the Pu-239 concentration. Ba-137m and Y-90 are assumed to be present at 100% equilibrium. Note that 1 Ci = 3.7E-2 TBq.

## SPRU DP Summary of Emissions

The emissions associated with point sources are based on numerous measurements of air particulate concentrations in stack effluents or ambient (general area) air samples. The exhaust flow rates are based on process knowledge and manufacturer's data. In assessing the data, the MDA was applied in place of the observed concentration whenever the observed concentration was less than the MDA. In this respect, the point source emissions data are biased conservatively. Exhaust flow rates were assumed constant based on process knowledge of the operating parameters.

All diffuse (non-point) emission quantities, except the unplanned release and debris pile emissions, were determined using process knowledge, 40 CFR 61, Appendix D or other EPA approved methods described in the EPA document *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities* (EPA 2004). The Ba-137m and Y-90 decay products of Cs-137 and Sr-90 are assumed to be present in full equilibrium. The abundance of Pu-241 relative to Pu-239 was estimated from characterization samples of building contamination, sludge and water and varied from 17.5% in groundwater to 45.4% in building contamination. Because Pu-241 decays to Am-241, the Pu-241 emission was added to the source term as an estimated percentage of the Pu-239 emission, in order to provide a conservative emission estimate.

Emissions from portable ventilation units in the E1/G1 tunnel were discharged to the basement of the E1 and G1 buildings. Emissions from the SPRU-DP operations in the E1/G1 tunnel and basement are reflected in KAPL's reporting of emissions from the Building E1/G1 Basement.

## Section III - Dose Assessment

### Description of Dose Model

The dose model used by KAPL, 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, one meter in height, central to the main emission points between both KAPL and SPRU DP. Diffuse source releases from KAPL, 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 south 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 10.5$^{o}$C were reduced from calendar year 2010 on-site meteorological measurements of wind speed, wind direction and standard deviation of horizontal wind direction, and temperature. Data reduction was performed in accordance with EPA-454/R-99-005, "Meteorological Monitoring Guidance for Regulatory Modeling Applications". The calendar year 2010 annual rainfall of 96.1 centimeters was taken from the Albany National Weather Service.

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 modeled stack to the nearest receptors were determined by KAPL with the use of ArcMap GIS software.

d. The food sources fractions used in the assessment were those listed for rural sites in the CAP88-PC Version 3.0 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 Version 3.0 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 ORNL-5532 (AIRDOS-EPA). A stack diameter of 0.5 meters was entered into the data to ensure the use of a non-zero value as required by Version 3.0.

b. The total radionuclide emissions from point sources were those from the KAPL Point Source Air Emission Data – 2010 Table 1, above. 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. Estimated emissions from unmonitored emission points were based on annual confirmatory measurements (e.g., radioactive material usage surveys). The diffuse source emissions were those taken from and described in the Non-Point Source Section above.

c. With the exception of the cobalt, strontium, yttrium, uranium and plutonium radionuclides, the default lung clearance types (“FGR 13 Type”) were assumed. For Sr-90 “Fast” was selected; and, for Co-60, Y-90, U-234, U-235, U-236, U-238, and Pu-238 radionuclides, “Slow” was selected. These lung clearance types were chosen using the guidance provided in DOE Order 5400.5.

**SPRU LA Specific Input Data**

a. The sources were considered to be area sources of approximately 16,187 $m^2$ for the Lower Level and 32,000 $m^2$ for the North Field. Radionuclide release rates were provided in Table 6 above.

b. A source height of 1 meter was used to model a ground level release but maintain stack or source height greater than zero per ORNL-5532 (AIRDOS-EPA).

**SPRU DP Specific Input Data**

a. Stack heights, diameters and diffuse source area dimensions are taken or calculated from engineering documents and are provided in Appendix C. Plume rise for point sources was modeled as momentum plume rise with zero velocity. Diffuse (area) sources are modeled as ground-level releases of one meter height and no velocity.

**KAPL Compliance Assessment - 2010**

| Effective Dose Equivalent | Location of Maximally Exposed Off-Site Individual (MEOSI) |
|---|---|
| 2.85E-04 mrem<br>(2.85E-03 µSv)* | A residence at about 450 meters in the south southwest sector |

** 1 mrem = 10 µSv*

The KAPL CAP88-PC calculations output are contained in Appendix A.

**Table 8 - Summary of KAPL Dose Equivalents for Calendar Year 2010**

| Sector | Distance to Nearest Receptor (meters) | Point Source Dose Equivalent (mrem/year) | Diffuse Source Dose Equivalent (mrem/year) | Total Dose Equivalent (mrem/year) | Notes |
|---|---|---|---|---|---|
| N | 1000 | 7.2E-05 | 1.1E-05 | 8.3E-05 | |
| NNW | 1300 | 6.4E-05 | 9.5E-06 | 7.4E-05 | |
| NNW | 550 | (7.3E-05) | (9.7E-06) | (8.3E-05) | Business* |
| NW | 2550 | 2.8E-05 | 4.8E-06 | 3.3E-05 | |
| NW | 700 | (2.2E-05) | (3.2E-06) | (2.5E-05) | Business* |
| WNW | 1050 | 3.7E-05 | 6.0E-06 | 4.3E-05 | |
| WNW | 775 | (1.6E-05) | (2.4E-06) | (1.8E-05) | Business* |
| W | 700 | 5.6E-05 | 8.4E-06 | 6.4E-05 | |
| WSW | 750 | 4.7E-05 | 7.3E-06 | 5.4E-05 | |
| SW | 450 | 1.9E-04 | 2.6E-05 | 2.2E-04 | |
| **SSW** | 450 | 2.52E-04 | 3.34E-05 | 2.85E-04 | **MEOSI** |
| S | 550 | 1.4E-04 | 1.9E-05 | 1.6E-04 | |
| SSE | 1650 | 4.5E-05 | 6.9E-06 | 5.2E-05 | |
| SE | 1650 | 5.0E-05 | 7.6E-06 | 5.8E-05 | |
| ESE | 1000 | 1.0E-04 | 1.5E-05 | 1.2E-04 | |
| E | 700 | 1.0E-04 | 1.4E-05 | 1.1E-04 | |
| ENE | 700 | 7.5E-05 | 1.1E-05 | 8.6E-05 | |
| NE | 700 | 6.8E-05 | 9.9E-06 | 7.8E-05 | |
| NNE | 950 | 5.2E-05 | 7.8E-06 | 6.0E-05 | |

*A correction factor of three 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 - 2010**

| Effective Dose Equivalent | Location of Maximally Exposed Off-Site Individual |
|---|---|
| 6.3E-02 mrem (6.3E-01 μSv)* | A residence at about 450 meters in the south southwest sector |

** 1 mrem = 10 μSv*

The SPRU LA CAP88-PC calculation output is contained in Appendix B. A correction factor of three has been applied to the CAP-88 PC doses for the nearest receptors at business locations. The adjusted doses are enclosed in parentheses. A summary of doses is provided in Table 9.

**Table 9 - Summary of SPRU LA Dose Equivalents for Calendar Year 2010**

| Sector | Distance to Nearest Receptor (meters)** | Diffuse Source Dose Equivalent (mrem/year) | Notes |
|---|---|---|---|
| N | 1000 | 1.3E-02 | |
| NNW | 1300 | 1.0E-02 | |
| NNW | 550 | (1.8E-02) | Business* |
| NW | 2550 | 1.0E-03 | |
| NW | 700 | (3.7E-03) | Business* |
| WNW | 1050 | 3.1E-03 | |
| WNW | 775 | (1.9E-03) | Business* |
| W | 700 | 8.3E-03 | |
| WSW | 750 | 5.9E-03 | |
| SW | 450 | 4.6E-02 | |
| **SSW** | **450** | **6.3E-02** | **MEOSI** |
| S | 550 | 3.3E-02 | |
| SSE | 1650 | 5.4E-03 | |
| SE | 1650 | 6.6E-03 | |
| ESE | 1000 | 2.1E-02 | |
| E | 700 | 2.1E-02 | |
| ENE | 700 | 1.4E-02 | |
| NE | 700 | 1.2E-02 | |
| NNE | 950 | 7.4E-03 | |

*A correction factor of three 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 from the center of the KAPL site, and the nearest school is approximately 1,700 m away. All distances to receptors are measured from the center of the KAPL 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 - 2010**

| Effective Dose Equivalent | Location of Maximally Exposed Off-Site Individual |
|---|---|
| 0.053 mrem (0.53 μSv)* | A residence at about 450 meters in the south southwest sector |

** 1 mrem = 10 μSv*

The CAP88-PC calculation output is contained in Appendix C. A correction factor of three has been applied to the CAP88 PC doses for the nearest receptors at business locations. The adjusted doses are enclosed in parentheses. The diffuse sources were evaluated using process knowledge, 40CFR61, Appendix D, or other approved methods described in the EPA document *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities* (EPA 2004).

**Table 10 - Summary of SPRU DP Dose Equivalents for Calendar Year 2010**

| Sector | Distance to Nearest Receptor (meters) | Point Source Dose Equivalent (mrem/year) | Diffuse Source Dose Equivalent (mrem/year) | Total Dose Equivalent (mrem/year) | Notes |
|---|---|---|---|---|---|
| N | 1000 | 9.9E-05 | 1.3E-02 | 1.3E-02 | |
| NNW | 1300 | 8.2E-05 | 1.1E-02 | 1.1E-02 | |
| NNW | 550 | (1.3E-04) | (1.5E-02) | (1.5E-02) | Business* |
| NW | 2550 | 1.4E-05 | 3.2E-03 | 3.2E-03 | |
| NW | 700 | (2.8E-05) | (3.7E-03) | (3.7E-03) | Business* |
| WNW | 1050 | 2.9E-05 | 5.1E-03 | 5.1E-03 | |
| WNW | 775 | (1.6E-05) | (2.4E-03) | (2.4E-03) | Business* |
| W | 700 | 6.7E-05 | 9.2E-03 | 9.2E-03 | |
| WSW | 750 | 5.0E-05 | 7.3E-03 | 7.3E-03 | |
| SW | 450 | 3.4E-04 | 4.0E-02 | 4.0E-02 | |
| **SSW** | **450** | **4.6E-04** | **5.3E-02** | **5.3E-02** | **MEOSI** |
| S | 550 | 2.4E-04 | 2.9E-02 | 2.9E-02 | |
| SSE | 1650 | 4.6E-05 | 6.8E-03 | 6.8E-03 | |
| SE | 1650 | 5.5E-05 | 7.9E-03 | 7.9E-03 | |
| ESE | 1000 | 1.6E-04 | 1.9E-02 | 1.9E-02 | |
| E | 700 | 1.6E-04 | 2.0E-02 | 2.0E-02 | |
| ENE | 700 | 1.1E-04 | 1.4E-02 | 1.4E-02 | |
| NE | 700 | 9.4E-05 | 1.2E-02 | 1.2E-02 | |
| NNE | 950 | 6.0E-05 | 8.4E-03 | 8.4E-03 | |

*A correction factor of three 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 - 2010**

| Effective Dose Equivalent | Location of Maximally Exposed Individual |
|---|---|
| 1.16E-01 mrem (1.16E00 µSv)* | A residence at about 450 meters in the south southwest sector |

* 1 mrem = 10 µSv

## Table 11 – Summary of DOE Knolls Site Dose Equivalents for Calendar Year 2010

| 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 | 8.30E-05 | 1.30E-02 | 1.30E-02 | 2.61E-02 | |
| NNW | 1300 | 7.40E-05 | 1.00E-02 | 1.10E-02 | 2.11E-02 | |
| NNW | 550 | 8.30E-05 | 1.80E-02 | 1.50E-02 | 3.31E-02 | Business* |
| NW | 2550 | 3.30E-05 | 1.00E-03 | 3.20E-03 | 4.23E-03 | |
| NW | 700 | 2.50E-05 | 3.70E-03 | 3.70E-03 | 7.43E-03 | Business* |
| WNW | 1050 | 4.30E-05 | 3.10E-03 | 5.10E-03 | 8.24E-03 | |
| WNW | 775 | 1.80E-05 | 1.90E-03 | 2.40E-03 | 4.32E-03 | Business* |
| W | 700 | 6.40E-05 | 8.30E-03 | 9.20E-03 | 1.76E-02 | |
| WSW | 750 | 5.40E-05 | 5.90E-03 | 7.30E-03 | 1.33E-02 | |
| SW | 450 | 2.20E-04 | 4.60E-02 | 4.00E-02 | 8.62E-02 | |
| **SSW** | **450** | **2.85E-04** | **6.30E-02** | **5.30E-02** | **1.16E-01** | **MEOSI** |
| S | 550 | 1.60E-04 | 3.30E-02 | 2.90E-02 | 6.22E-02 | |
| SSE | 1650 | 5.20E-05 | 5.40E-03 | 6.80E-03 | 1.23E-02 | |
| SE | 1650 | 5.80E-05 | 6.60E-03 | 7.90E-03 | 1.46E-02 | |
| ESE | 1000 | 1.20E-04 | 2.10E-02 | 1.90E-02 | 4.01E-02 | |
| E | 700 | 1.10E-04 | 2.10E-02 | 2.00E-02 | 4.11E-02 | |
| ENE | 700 | 8.60E-05 | 1.40E-02 | 1.40E-02 | 2.81E-02 | |
| NE | 700 | 7.80E-05 | 1.20E-02 | 1.20E-02 | 2.41E-02 | |
| NNE | 950 | 6.00E-05 | 7.40E-03 | 8.40E-03 | 1.59E-02 | |

## 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 2010 but for which the requirement to apply for approval to construct or modify was waived under 40 CFR 61.96.

### KAPL

During 2010, 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

There were no construction or facility modification activities that affected the generation or control of emissions from the project site during 2010.

### SPRU DP

The following construction and modification activities were initiated at SPRU DP but not completed in 2010:

- D&D of Building H2
- D&D of Building G2 and separation from Building G1
- Sludge processing

These activities were initiated after evaluations indicated that the dose to the MEOSI for each activity would be less than 0.1 mrem EDE per year. At the end of September 2010, these activities were terminated following an unplanned release. SPRU DP subsequently entered a maintenance phase pending installation of enclosures and HEPA ventilation exhaust systems for the remaining D&D of Buildings H2 and G2.

### Unplanned Releases

### KAPL

There were no unplanned releases to the atmosphere.

### SPRU LA

There were no unplanned releases to the atmosphere.

### SPRU DP

On September 29, 2010, a radioactive contamination event occurred while performing open air size reduction of Building H2 process equipment at the site. SPRU DP performed an analysis shortly after the release using information from general area and work area boundary air samples. Meteorological data were obtained from KAPL that detailed the dispersion conditions in 15-minute increments. The wind data showed that the wind direction shifted from 181 degrees at 0800 to 283 degrees at 1130. This corresponds to wind blowing to the north at 0800 and shifting clockwise to the east by 1130.

Radiochemical analysis was performed by an offsite laboratory on the two air filters with the highest gross radioactivity readings. This analysis was used to characterize the radionuclide ratios in the release. The radionuclide content of the remaining filters was determined by gross measurement of the beta-gamma content and application of radionuclide ratios to calculate the activity of the alpha-emitting radionuclides.

*Emission Estimates*

Based on the meteorological and radiological information, SPRU DP analyzed the release in three segments, corresponding to wind shifts from south (S) to east (E) during the period 0800 to 1130 and corresponding to the three sectors (NW, NE and E) where radioactive material was collected on air sample filters. The analysis used the HotSpot code, which was developed by Lawrence Livermore National Laboratory's National Atmospheric Release Advisory Center (NARAC) as a tool for "evaluating incidents involving radioactive material (www.narac.llnl.gov)." HotSpot is a straight-line Gaussian dispersion code. The air sample locations were located at the same elevation as the demolition activities that led to the release. There were no buildings between the location of the work and the air samplers. However, the air samplers in the NE sector and the E sector were adjacent to buildings, which likely induced some wake effects. Overall, building wake effects are expected to be minor. Total emission of 379 µCi of Sr-90 equivalent and 34 µCi of Pu-239 equivalent were calculated. The analysis indicated that the release occurred primarily in the east direction, with 239 of the 379 µCi of Sr-90 equivalent released to the east, 133 µCi of Sr-90 equivalent released in the NE direction, and 7 µCi of Sr-90 equivalent released in the NW sector.

KAPL used NARAC's puff advection plume model to independently analyze the emission. The puff analysis code uses a Lagrangian Monte Carlo dispersion model. KAPL's analysis assumed that the release occurred at a steady rate between 0900 and 1100 when the wind was generally blowing into the NE sector. This analysis back calculated the emission based on the calculated dispersion and an air sample from the lower level (LL2-J6). The LL2-J6 location is at a lower elevation than the release point and there are buildings between the location of the release and the point of measurement. This latter analysis resulted in an estimate of gross beta-gamma emission of 1980 µCi, which is equivalent to 990 µCi of Sr-90 and 164 µCi of alpha, which is evaluated as Pu-239, being released in the NE direction. A review of the surface contamination surveys of the KAPL site after the unplanned release indicated that the largest deposition of reported contamination was in the east and southeast directions, relative to the location of work.

The main assumptions that result in differences between the KAPL release quantity estimate and the SPRU release quantity estimate are the modeled direction of release (NE by KAPL, NW through E by SPRU DP), the assumption of constant release rate (KAPL) versus independent releases in three sectors (SPRU DP), and the above uncertainties associated with dispersion modeling, which are principally elevation and building effects.

A recent recomparison of the air concentration measured at LL2-J6 and the air concentrations measured at SPRU's NW, NE and E work area boundaries determined that the measurements are consistent if the wind is assumed to blow to the east during the period when radioactive contamination was collected on the LL2-J6 filter. Under this assumption, the difference between emission based on the E work area boundary sample and the LL2-J6 sample is 14%. Therefore the previously calculated emissions of 379 µCi of Sr-90 and 34 µCi of Pu-239 were adjusted upward by 14% to 432 µCi of Sr-90 equivalent and 39 µCi of Pu-239 equivalent in order to provide a conservative estimate of the release for the 2010 compliance report. These values are included in the radionuclide specific data in the Unplanned Release column of Table 7.

The adjustment changes the calculated release in the NE sector to 152 µCi of Sr-90 and 14 µCi of Pu-239. The revised equivalent estimate for the E sector is 272 µCi of Sr-90 and 24 µCi of Pu-239.

An additional 1% was added to the emission for 2010 to account for fugitive emissions from the debris pile during the period of custody from September 30, 2010 to December 31, 2010. This 1% addition is an estimated fugitive release from the debris pile during the fourth quarter of 2010 based on engineering judgments of potential emissions. This additional 1% is not included in estimates of releases on September 29, 2010.

This updated release estimate is more conservative than the estimate by SPRU DP shortly after the unplanned release and lower than the values previously estimated by KAPL. A range of estimates is not unexpected in dealing with an unplanned release of the type than occurred on September 29, 2010. The original estimates were based on reasonable assumptions.

*Dose Analysis*

An analysis of the dose to the maximally impacted offsite receptor was performed by SPRU DP shortly after the incident using the initial emission estimate and the HotSpot code. The dose estimate assumed a segmented plume that was released in three directions. Meteorological data from KAPL's tower were used for the dispersion calculation. The HotSpot calculation included only inhalation, immersion and ground plane exposure using FGR 13 dose factors for total equivalent dose (TED). SPRU DP modeled Pu-239 as Type S (5.92E+7 rem/curie) and Sr-90 as Type M (1.32E+5 rem/curie) under FGR 13 criteria. The doses at the offsite locations were calculated assuming that the maximally exposed individual was located on the plume centerline and incurred dose from resuspension and ground plane exposure for a period of one year. There is no food pathway exposure included in the dose. The purpose of the SPRU DP calculation was to evaluate the unplanned release and was not intended to evaluate compliance with Subpart H of 40 CFR 61. The dose to a receptor 650 m from SPRU in the NE sector was calculated to be 0.0039 mrem and the dose to a receptor 730 m from SPRU in the E sector was calculated to be 0.0042 mrem TED.

A calculation was also performed by KAPL using NARAC's puff advection plume model. This calculation assumed that the unplanned release took place over a two hour period from 0900 to 1100 when the wind direction was predominantly to the NE. The analysis determined that that concentration at the nearest receptor in the NE sector was 1.317E-06 µCi/mL per 1000 Ci released during the two hour period. The analysis determined that 1980 µCi of gross beta (990 µCi Sr-90, assuming equilibrium with Y-90) and 164 µCi of alpha (Pu-239) contamination were released. The dose conversion that KAPL used for Pu-239 is based on breathing 5E-12 µCi/mL for one hour resulting in a dose of 2.5 mrem, which is derived from EPA FGR 11. The Sr-90 dose conversion is based on breathing 2E-09 µCi/mL for one hour resulting in 2.5 mrem. Assuming that a receptor inhaled contaminated air at the rate of 3.33E-04 $m^3$/s for 120 minutes following the above releases, the dose to the receptor would be 0.2 mrem for Pu-239 and insignificant for Sr-90.

The dose conversion factor used by KAPL is equivalent to approximately 4.17E+8 rem/curie (FGR 11), compared to 5.92E+7 rem/curie for Type S Pu-239 in FGR 13. The emission estimated by KAPL in the NE sector is 164 µCi of Pu-239 and the emission estimated by SPRU DP is currently 14 µCi.

If the updated emissions calculated by SPRU DP for the NE sector, 152 µCi of Sr-90 and 14 µCi of Pu-239, are inserted into the analysis using the NARAC puff model and the SPRU DP dose conversion factors, the resulting dose to the receptor in the NE sector would be 0.0026 mrem for Pu-239 and would be insignificant for Sr-90. This is relatively consistent with the 0.0039 mrem reported by SPRU DP using HotSpot. This difference in the doses appears to lie within the uncertainty of the dispersion calculations. The difference in the dose calculations for the receptor in the NE sector is therefore primarily due to differences in the emission estimates and the dose conversion factors.

The FGR 13 inhalation dose conversion factor for Type M Pu-239 is 1.86E+8 rem/curie. This inhalation conversion factor is more conservative than the Type S dose conversion factor in FGR 13 and similar to the dose conversion factor used by KAPL from the older guidance in FGR 11, which was based on Class Y biological clearance. The CAP88-PC Version 3.0 User Guide states that Type S clearance is analogous to Class Y. By replacing the Type S conversion factor with the Type M conversion factor, which is similar to the FGR 11 conversion factor, the dose to the receptor in the NE sector is calculated to be 0.008 mrem. The dose to the receptor in the E sector is similar in magnitude to the dose to the receptor in the NE sector because the higher emission is compensated by greater meteorological dispersion. The Sr-90 emission is not significant from the viewpoint of dose because it contributes less than 1% of the total dose.

*Current Assessment*

The current assessment of plume exposure dose to the closest receptors following the unplanned release of September 29, 2010 is that the calculated dose to the receptors in the NE and E sectors was 0.008 mrem. This assessment is more conservative than the previous estimate of approximately 0.004 mrem. Although the original estimate was based on reasonable and appropriate bases, the current assessment is more conservative.

The present CAP88 analysis, which conforms to the requirements of 40 CFR 61.92, estimates the dose from total diffuse releases in 2010 is 0.020 to 0.012 mrem/year at the nearest receptors in the E and NE sectors, both at a distance of 700 m from the KAPL site. The MEOSI dose is 0.053 mrem/year at a receptor 450 m from the KAPL site in the SSW sector. Although these doses include all of the calculated diffuse emissions, the unplanned release represents the vast majority of diffuse emissions, constituting at least 99% of the Pu-239, Am-241 and Sr-90 emission and 75% of the Cs-137 emission. The CAP88 code includes food pathways, a 100 year environmental buildup period, and includes annual meteorology, which includes periods of low dispersion. On the morning of September 29, 2010, the meteorological conditions were characterized as A, B and C stability class categories, which are high dispersion conditions that reduce the effective dose per unit of radioactive emission. On an annual basis, stability class D is most frequent in the E sector and stability class F is most frequent in the NE sector, as seen in the CAP88 weather file (attached). The two code results are not directly comparable. The current assessment using Type M dose conversion factors and a more conservative emission estimate is considered a reasonably conservative representation of the dose that occurred on the day of the release and the CAP88 result is considered to be indicative of compliance with Subpart H of 40 CFR 61.

## References

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

40 CFR 61, Appendix D, "Methods for Estimating Radionuclide Emission," *Code of Federal Regulations*, Office of the Federal Register, current revision.

40 CFR 61, "Subpart H, Department of Energy Facilities," *Code of Federal Regulations*, Office of the Federal Register, current revision.

40 CFR 61.94, "Compliance and Reporting," *Code of Federal Regulations*, Office of the Federal Register, current revision.

EPA, 2004, *Methods for Estimating Fugitive Air Emissions of Radionuclides from Diffuse Sources at DOE Facilities*, September 3, 2004

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.

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.

ORNL-5532 (AIRDOS-EPA), "A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides," R. E. Moore, C. F. Baes, III, L. M. McDowell-Boyer, A. P. Watson, F. O. Hoffman, J. C. Pleasant, C. W. Miller, 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: 6/29/11

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

Signature: _____ Date: 6/28/11

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

# APPENDIX A

# Knolls Atomic Power Laboratory

# (KAPL)

# CAP88-PC OUTPUT

# Point Source

# CAP88-PC

# Calculation

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
May 5, 2011 01:23 pm

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

Source Category: DOE FACILITY
Source Type: Stack
Emission Year: 2010

Comments: KNOLLS 2010 EMISSIONS
MAXIMALLY EXPOSED INDIVIDUAL

| Effective Dose Equivalent (mrem/year) |
|---|
| 2.52E-04 |

At This Location: 450 Meters South Southwest

Dataset Name: KNOMEI2010
Dataset Date: 5/5/2011 12:45:00 PM
Wind File: C:\Program Files\CAP88-PC30\WindLib\KAPL2010

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters South Southwest
Lifetime Fatal Cancer Risk: 1.60E-10

ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Dose Equivalent (mrem/y) |
|---|---|
| Adrenals | 5.38E-05 |
| B Surfac | 1.41E-03 |
| Breasts | 4.40E-05 |
| St Wall | 5.24E-05 |
| ULI Wall | 7.24E-05 |
| Kidneys | 5.25E-05 |
| Lungs | 9.37E-05 |
| Ovaries | 5.49E-05 |
| R Marrow | 6.41E-04 |
| Spleen | 5.20E-05 |
| Thymus | 5.05E-05 |
| Uterus | 5.53E-05 |
| Bld Wall | 5.81E-05 |
| Brain | 4.59E-05 |
| Esophagu | 7.07E-05 |
| SI Wall | 5.53E-05 |
| LLI Wall | 1.33E-04 |
| Liver | 5.30E-05 |
| Muscle | 4.88E-05 |
| Pancreas | 5.50E-05 |
| Skin | 1.05E-04 |
| Testes | 4.89E-05 |
| Thyroid | 5.06E-05 |
| EFFEC | 2.52E-04 |

RADIONUCLIDE EMISSIONS DURING THE YEAR 2010

| Nuclide | Type | Size | Source #1 Ci/y | TOTAL Ci/y |
|---|---|---|---|---|
| Cs-137 | F | 1 | 3.0E-06 | 3.0E-06 |
| Ba-137m | M | 1 | 0.0E+00 | 0.0E+00 |
| Sr-90 | F | 1 | 3.0E-06 | 3.0E-06 |
| Y-90 | M | 1 | 0.0E+00 | 0.0E+00 |
| Y-90 | S | 1 | 3.0E-06 | 3.0E-06 |
| Kr-85 | G | 0 | 2.7E-02 | 2.7E-02 |
| H-3 | V | 0 | 1.4E-07 | 1.4E-07 |
| Co-60 | S | 1 | 2.6E-08 | 2.6E-08 |
| Pu-238 | S | 1 | 2.1E-08 | 2.1E-08 |
| U-238 | S | 1 | 6.6E-11 | 6.6E-11 |
| U-235 | S | 1 | 1.0E-08 | 1.0E-08 |
| U-236 | S | 1 | 1.9E-09 | 1.9E-09 |
| U-234 | S | 1 | 6.1E-07 | 6.1E-07 |

SITE INFORMATION

Temperature: 11 degrees C
Precipitation: 96 cm/y
Humidity: 8 g/cu m
Mixing Height: 1000 m

User specified location of max exposed individual.
(ILOC, JLOC): 8, 1

SOURCE INFORMATION

Source Number: 1

Stack Height (m): 1.00
Diameter (m): 0.50

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 | 80000 | | |

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
May 5, 2011 01:23 pm

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

Source Category: DOE FACILITY
Source Type: Stack
Emission Year: 2010

Comments: KNOLLS 2010 EMISSIONS
MAXIMALLY EXPOSED INDIVIDUAL

Dataset Name: KNOMEI2010
Dataset Date: 5/5/2011 12:45:00 PM
Wind File: .C:\Program Files\CAP88-PC30\WindLib\KAPL2010.WND

ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Selected Individual (mrem/y) |
|---|---|
| Adrenals | 5.38E-05 |
| B Surfac | 1.41E-03 |
| Breasts | 4.40E-05 |
| St Wall | 5.24E-05 |
| ULI Wall | 7.24E-05 |
| Kidneys | 5.25E-05 |
| Lungs | 9.37E-05 |
| Ovaries | 5.49E-05 |
| R Marrow | 6.41E-04 |
| Spleen | 5.20E-05 |
| Thymus | 5.05E-05 |
| Uterus | 5.53E-05 |
| Bld Wall | 5.81E-05 |
| Brain | 4.59E-05 |
| Esophagu | 7.07E-05 |
| SI Wall | 5.53E-05 |
| LLI Wall | 1.33E-04 |
| Liver | 5.30E-05 |
| Muscle | 4.88E-05 |
| Pancreas | 5.50E-05 |
| Skin | 1.05E-04 |
| Testes | 4.89E-05 |
| Thyroid | 5.06E-05 |
| EFFEC | 2.52E-04 |

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

| Pathway | Selected Individual (mrem/y) |
|---|---|
| INGESTION | 1.40E-04 |
| INHALATION | 1.09E-04 |
| AIR IMMERSION | 5.52E-07 |
| GROUND SURFACE | 1.85E-06 |
| INTERNAL | 2.49E-04 |
| EXTERNAL | 2.40E-06 |
| TOTAL | 2.52E-04 |

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

| Nuclide | Selected Individual (mrem/y) |
|---|---|
| Cs-137 | 4.83E-05 |
| Ba-137m | 1.54E-06 |
| Sr-90 | 9.14E-05 |
| Y-90 | 3.05E-07 |
| Y-90 | 8.27E-08 |
| Kr-85 | 5.47E-07 |
| H-3 | 8.37E-11 |
| Co-60 | 1.40E-08 |
| Pu-238 | 5.80E-06 |
| U-234 | 0.00E+00 |
| 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 |
| At-218 | 0.00E+00 |
| U-238 | 0.00E+00 |
| Th-234 | 0.00E+00 |
| Pa-234m | 0.00E+00 |
| Pa-234 | 0.00E+00 |
| U-235 | 1.51E-06 |
| Th-231 | 0.00E+00 |
| Pa-231 | 0.00E+00 |
| Ac-227 | 0.00E+00 |
| Th-227 | 0.00E+00 |
| Fr-223 | 0.00E+00 |
| U-236 | 2.89E-07 |
| Th-232 | 0.00E+00 |
| Ra-228 | 0.00E+00 |
| Ac-228 | 0.00E+00 |
| Th-228 | 0.00E+00 |
| U-234 | 1.02E-04 |
| TOTAL | 2.52E-04 |

CANCER RISK SUMMARY

| Cancer | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Esophagu | 5.61E-13 |
| Stomach | 2.07E-12 |
| Colon | 1.27E-11 |
| Liver | 9.79E-13 |
| LUNG | 8.48E-11 |
| Bone | 2.05E-12 |
| Skin | 1.04E-13 |
| Breast | 1.75E-12 |
| Ovary | 6.90E-13 |
| Bladder | 1.50E-12 |
| Kidneys | 3.49E-13 |
| Thyroid | 1.41E-13 |
| Leukemia | 4.52E-11 |
| Residual | 7.42E-12 |
| Total | 1.60E-10 |
| TOTAL | 3.21E-10 |

PATHWAY RISK SUMMARY

| Pathway | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| INGESTION | 7.78E-11 |
| INHALATION | 8.15E-11 |
| AIR IMMERSION | 1.67E-13 |
| GROUND SURFACE | 8.65E-13 |
| INTERNAL | 1.59E-10 |
| EXTERNAL | 1.03E-12 |
| TOTAL | 1.60E-10 |

NUCLIDE RISK SUMMARY

| Nuclide | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Cs-137 | 2.45E-11 |
| Ba-137m | 8.29E-13 |
| Sr-90 | 5.34E-11 |
| Y-90 | 4.05E-14 |
| Y-90 | 8.30E-14 |
| Kr-85 | 1.65E-13 |
| H-3 | 4.75E-17 |
| Co-60 | 1.05E-14 |
| Pu-238 | 3.27E-12 |
| U-234 | 0.00E+00 |
| 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 |
| At-218 | 0.00E+00 |
| U-238 | 0.00E+00 |
| Th-234 | 0.00E+00 |
| Pa-234m | 0.00E+00 |
| Pa-234 | 0.00E+00 |
| U-235 | 1.15E-12 |
| Th-231 | 0.00E+00 |
| Pa-231 | 0.00E+00 |
| Ac-227 | 0.00E+00 |
| Th-227 | 0.00E+00 |
| Fr-223 | 0.00E+00 |
| U-236 | 2.20E-13 |
| Th-232 | 0.00E+00 |
| Ra-228 | 0.00E+00 |
| Ac-228 | 0.00E+00 |
| Th-228 | 0.00E+00 |
| U-234 | 7.67E-11 |
| TOTAL | 1.60E-10 |

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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 450 | 550 | 700 | 750 | 775 | 950 | 1000 |
| N | 2.4E-04 | 1.7E-04 | 1.2E-04 | 1.1E-04 | 1.0E-04 | 7.7E-05 | 7.2E-05 |
| NNW | 3.1E-04 | 2.2E-04* | 1.5E-04 | 1.3E-04 | 1.2E-04 | 9.2E-05 | 8.6E-05 |
| NW | 1.2E-04 | 8.9E-05 | 6.5E-05* | 6.0E-05 | 5.8E-05 | 4.7E-05 | 4.5E-05 |
| WNW | 8.8E-05 | 6.7E-05 | 5.1E-05 | 4.8E-05 | 4.7E-05* | 3.9E-05 | 3.8E-05 |
| W | 9.8E-05 | 7.4E-05 | 5.6E-05 | 5.2E-05 | 5.0E-05 | 4.2E-05 | 4.0E-05 |
| WSW | 8.5E-05 | 6.6E-05 | 5.0E-05 | 4.7E-05 | 4.6E-05 | 3.9E-05 | 3.7E-05 |
| SW | 1.9E-04 | 1.4E-04 | 9.8E-05 | 8.9E-05 | 8.5E-05 | 6.5E-05 | 6.2E-05 |
| SSW | 2.5E-04 | 1.8E-04 | 1.2E-04 | 1.1E-04 | 1.0E-04 | 7.7E-05 | 7.2E-05 |
| S | 2.0E-04 | 1.4E-04 | 9.8E-05 | 8.8E-05 | 8.4E-05 | 6.4E-05 | 6.0E-05 |
| SSE | 2.6E-04 | 1.8E-04 | 1.2E-04 | 1.1E-04 | 1.1E-04 | 7.9E-05 | 7.3E-05 |
| SE | 3.1E-04 | 2.2E-04 | 1.4E-04 | 1.3E-04 | 1.2E-04 | 9.1E-05 | 8.4E-05 |
| ESE | 3.7E-04 | 2.6E-04 | 1.8E-04 | 1.6E-04 | 1.5E-04 | 1.1E-04 | 1.0E-04 |
| E | 2.1E-04 | 1.5E-04 | 1.0E-04 | 9.3E-05 | 8.9E-05 | 6.8E-05 | 6.4E-05 |
| ENE | 1.4E-04 | 1.0E-04 | 7.5E-05 | 6.8E-05 | 6.6E-05 | 5.2E-05 | 4.9E-05 |
| NE | 1.3E-04 | 9.5E-05 | 6.8E-05 | 6.3E-05 | 6.0E-05 | 4.8E-05 | 4.6E-05 |
| NNE | 1.4E-04 | 1.0E-04 | 7.4E-05 | 6.8E-05 | 6.5E-05 | 5.2E-05 | 4.9E-05 |

| | Distance (m) | | | | |
|---|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 | 80000 |
| N | 6.8E-05 | 5.5E-05 | 4.5E-05 | 3.4E-05 | 2.4E-05 |
| NNW | 8.1E-05 | 6.4E-05 | 5.1E-05 | 3.7E-05 | 2.4E-05 |
| NW | 4.3E-05 | 3.7E-05 | 3.3E-05 | 2.8E-05 | 2.4E-05 |
| WNW | 3.7E-05 | 3.3E-05 | 3.0E-05 | 2.7E-05 | 2.4E-05 |
| W | 3.9E-05 | 3.4E-05 | 3.1E-05 | 2.7E-05 | 2.4E-05 |
| WSW | 3.6E-05 | 3.3E-05 | 3.0E-05 | 2.7E-05 | 2.4E-05 |
| SW | 5.9E-05 | 4.8E-05 | 4.0E-05 | 3.2E-05 | 2.4E-05 |
| SSW | 6.8E-05 | 5.5E-05 | 4.4E-05 | 3.4E-05 | 2.4E-05 |
| S | 5.7E-05 | 4.7E-05 | 3.9E-05 | 3.1E-05 | 2.4E-05 |
| SSE | 6.9E-05 | 5.5E-05 | 4.5E-05 | 3.4E-05 | 2.4E-05 |
| SE | 7.9E-05 | 6.3E-05 | 5.0E-05 | 3.6E-05 | 2.4E-05 |
| ESE | 9.7E-05 | 7.5E-05 | 5.8E-05 | 4.1E-05 | 2.4E-05 |
| E | 6.1E-05 | 5.0E-05 | 4.1E-05 | 3.2E-05 | 2.4E-05 |
| ENE | 4.7E-05 | 4.0E-05 | 3.5E-05 | 2.9E-05 | 2.4E-05 |
| NE | 4.4E-05 | 3.8E-05 | 3.3E-05 | 2.8E-05 | 2.4E-05 |
| NNE | 4.7E-05 | 4.0E-05 | 3.4E-05 | 2.9E-05 | 2.4E-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 | 1.6E-10 | 1.1E-10 | 7.4E-11 | 6.7E-11 | 6.3E-11 | 4.7E-11 | 4.4E-11 |
| NNW | 2.0E-10 | 1.4E-10 | 9.2E-11 | 8.2E-11 | 7.8E-11 | 5.7E-11 | 5.3E-11 |
| NW | 7.5E-11 | 5.5E-11 | 4.0E-11 | 3.6E-11 | 3.5E-11 | 2.8E-11 | 2.7E-11 |
| WNW | 5.4E-11 | 4.1E-11 | 3.1E-11 | 2.9E-11 | 2.8E-11 | 2.3E-11 | 2.2E-11 |
| W | 6.1E-11 | 4.6E-11 | 3.4E-11 | 3.1E-11 | 3.0E-11 | 2.5E-11 | 2.4E-11 |
| WSW | 5.2E-11 | 4.0E-11 | 3.0E-11 | 2.8E-11 | 2.7E-11 | 2.3E-11 | 2.2E-11 |
| SW | 1.2E-10 | 8.8E-11 | 6.1E-11 | 5.5E-11 | 5.2E-11 | 4.0E-11 | 3.7E-11 |
| SSW | 1.6E-10 | 1.1E-10 | 7.5E-11 | 6.8E-11 | 6.4E-11 | 4.8E-11 | 4.4E-11 |
| S | 1.3E-10 | 9.0E-11 | 6.1E-11 | 5.5E-11 | 5.2E-11 | 3.9E-11 | 3.7E-11 |
| SSE | 1.7E-10 | 1.2E-10 | 7.7E-11 | 6.9E-11 | 6.6E-11 | 4.8E-11 | 4.5E-11 |
| SE | 2.0E-10 | 1.4E-10 | 9.1E-11 | 8.1E-11 | 7.7E-11 | 5.6E-11 | 5.2E-11 |
| ESE | 2.4E-10 | 1.7E-10 | 1.1E-10 | 1.0E-10 | 9.5E-11 | 6.9E-11 | 6.4E-11 |
| E | 1.3E-10 | 9.3E-11 | 6.4E-11 | 5.8E-11 | 5.5E-11 | 4.2E-11 | 3.9E-11 |
| ENE | 9.1E-11 | 6.6E-11 | 4.6E-11 | 4.2E-11 | 4.0E-11 | 3.1E-11 | 3.0E-11 |
| NE | 8.1E-11 | 5.9E-11 | 4.2E-11 | 3.8E-11 | 3.7E-11 | 2.9E-11 | 2.7E-11 |
| NNE | 8.9E-11 | 6.5E-11 | 4.5E-11 | 4.1E-11 | 4.0E-11 | 3.1E-11 | 2.9E-11 |

| | Distance (m) | | | | |
|---|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 | 80000 |
| N | 4.2E-11 | 3.3E-11 | 2.6E-11 | 2.0E-11 | 1.3E-11 |
| NNW | 5.0E-11 | 3.9E-11 | 3.0E-11 | 2.1E-11 | 1.3E-11 |
| NW | 2.5E-11 | 2.2E-11 | 1.9E-11 | 1.6E-11 | 1.3E-11 |
| WNW | 2.1E-11 | 1.9E-11 | 1.7E-11 | 1.5E-11 | 1.3E-11 |
| W | 2.3E-11 | 2.0E-11 | 1.8E-11 | 1.5E-11 | 1.3E-11 |
| WSW | 2.1E-11 | 1.9E-11 | 1.7E-11 | 1.5E-11 | 1.3E-11 |
| SW | 3.5E-11 | 2.9E-11 | 2.4E-11 | 1.8E-11 | 1.3E-11 |
| SSW | 4.2E-11 | 3.3E-11 | 2.6E-11 | 1.9E-11 | 1.3E-11 |
| S | 3.5E-11 | 2.8E-11 | 2.3E-11 | 1.8E-11 | 1.3E-11 |
| SSE | 4.2E-11 | 3.3E-11 | 2.7E-11 | 1.9E-11 | 1.3E-11 |
| SE | 4.9E-11 | 3.8E-11 | 3.0E-11 | 2.1E-11 | 1.3E-11 |
| ESE | 6.0E-11 | 4.6E-11 | 3.5E-11 | 2.4E-11 | 1.3E-11 |
| E | 3.7E-11 | 3.0E-11 | 2.4E-11 | 1.9E-11 | 1.3E-11 |
| ENE | 2.8E-11 | 2.4E-11 | 2.0E-11 | 1.6E-11 | 1.3E-11 |
| NE | 2.6E-11 | 2.2E-11 | 1.9E-11 | 1.6E-11 | 1.3E-11 |
| NNE | 2.8E-11 | 2.3E-11 | 2.0E-11 | 1.6E-11 | 1.3E-11 |

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
May 5, 2011 01:23 pm

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

Source Category: DOE FACILITY
Source Type: Stack
Emission Year: 2010

Comments: KNOLLS 2010 EMISSIONS
MAXIMALLY EXPOSED INDIVIDUAL

Dataset Name: KNOMEI2010
Dataset Date: 5/5/2011 12:45:00 PM
Wind File: C:\Program Files\CAP88-PC30\WindLib\KAPL2010.WND

May 5, 2011 01:23 pm WEATHER
Page 1

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G | Wind Freq |
| N | 1.351 | 1.830 | 2.140 | 1.622 | 1.115 | 0.859 | 0.000 | 0.069 |
| NNW | 1.236 | 1.520 | 2.902 | 2.560 | 1.162 | 1.090 | 0.000 | 0.097 |
| NW | 0.886 | 1.741 | 4.373 | 2.625 | 0.982 | 0.855 | 0.000 | 0.030 |
| WNW | 0.823 | 1.026 | 1.052 | 1.312 | 0.772 | 0.808 | 0.000 | 0.024 |
| W | 0.778 | 0.824 | 0.862 | 1.325 | 0.834 | 0.792 | 0.000 | 0.022 |
| WSW | 0.792 | 0.935 | 1.078 | 1.952 | 0.806 | 0.772 | 0.000 | 0.023 |
| SW | 0.899 | 1.508 | 1.758 | 2.569 | 1.448 | 0.929 | 0.000 | 0.069 |
| SSW | 0.899 | 1.587 | 3.410 | 4.172 | 1.782 | 0.917 | 0.000 | 0.054 |
| S | 0.839 | 1.187 | 0.000 | 2.572 | 0.931 | 0.794 | 0.000 | 0.031 |
| SSE | 0.978 | 1.067 | 0.998 | 0.908 | 0.879 | 0.806 | 0.000 | 0.044 |
| SE | 1.134 | 2.062 | 3.069 | 2.317 | 1.039 | 0.866 | 0.000 | 0.079 |
| ESE | 1.344 | 2.900 | 4.286 | 3.796 | 1.498 | 0.938 | 0.000 | 0.279 |
| E | 1.286 | 2.483 | 4.484 | 3.667 | 1.430 | 0.875 | 0.000 | 0.101 |
| ENE | 1.066 | 2.307 | 4.054 | 2.781 | 1.187 | 0.806 | 0.000 | 0.030 |
| NE | 1.027 | 1.952 | 2.679 | 1.130 | 1.007 | 0.797 | 0.000 | 0.023 |
| NNE | 0.948 | 1.826 | 1.539 | 1.221 | 0.965 | 0.789 | 0.000 | 0.026 |

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 1.875 | 2.677 | 3.373 | 2.525 | 1.574 | 1.033 | 0.000 |
| NNW | 1.737 | 2.315 | 4.086 | 3.519 | 1.688 | 1.522 | 0.000 |
| NW | 1.103 | 2.362 | 4.373 | 3.335 | 1.393 | 1.022 | 0.000 |
| WNW | 0.932 | 1.409 | 1.937 | 2.572 | 0.772 | 0.888 | 0.000 |
| W | 0.792 | 0.936 | 1.143 | 1.846 | 0.964 | 0.837 | 0.000 |
| WSW | 0.837 | 1.222 | 1.574 | 3.472 | 0.880 | 0.772 | 0.000 |
| SW | 1.137 | 2.171 | 2.684 | 3.191 | 1.973 | 1.208 | 0.000 |
| SSW | 1.136 | 2.415 | 3.646 | 4.249 | 2.410 | 1.180 | 0.000 |
| S | 0.978 | 1.672 | 0.000 | 2.572 | 1.212 | 0.845 | 0.000 |
| SSE | 1.314 | 1.593 | 1.354 | 1.429 | 1.157 | 0.882 | 0.000 |
| SE | 1.594 | 2.913 | 4.115 | 3.397 | 1.463 | 1.053 | 0.000 |
| ESE | 1.867 | 3.351 | 4.565 | 4.398 | 2.019 | 1.227 | 0.000 |
| E | 1.801 | 3.197 | 4.712 | 4.495 | 1.956 | 1.076 | 0.000 |
| ENE | 1.482 | 2.959 | 4.242 | 3.730 | 1.672 | 0.880 | 0.000 |
| NE | 1.411 | 2.647 | 3.251 | 1.822 | 1.372 | 0.855 | 0.000 |
| NNE | 1.249 | 2.346 | 2.055 | 1.775 | 1.287 | 0.830 | 0.000 |

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 0.1848 | 0.1415 | 0.0348 | 0.1813 | 0.2163 | 0.2414 | 0.0000 |
| NNW | 0.2264 | 0.1073 | 0.0755 | 0.1451 | 0.1344 | 0.3113 | 0.0000 |
| NW | 0.5214 | 0.0344 | 0.0191 | 0.0458 | 0.0765 | 0.3028 | 0.0000 |
| WNW | 0.6465 | 0.0814 | 0.0142 | 0.0092 | 0.0288 | 0.2199 | 0.0000 |
| W | 0.4504 | 0.1151 | 0.0731 | 0.0260 | 0.0471 | 0.2883 | 0.0000 |
| WSW | 0.4021 | 0.0787 | 0.0979 | 0.1861 | 0.0783 | 0.1570 | 0.0000 |
| SW | 0.3378 | 0.1204 | 0.1054 | 0.1120 | 0.1103 | 0.2141 | 0.0000 |
| SSW | 0.3454 | 0.0486 | 0.0105 | 0.0296 | 0.0699 | 0.4960 | 0.0000 |
| S | 0.3506 | 0.0070 | 0.0000 | 0.0035 | 0.0143 | 0.6245 | 0.0000 |
| SSE | 0.2685 | 0.0338 | 0.0077 | 0.0286 | 0.1092 | 0.5521 | 0.0000 |
| SE | 0.1337 | 0.0770 | 0.0756 | 0.2443 | 0.1439 | 0.3255 | 0.0000 |
| ESE | 0.0379 | 0.0848 | 0.2343 | 0.5068 | 0.0630 | 0.0733 | 0.0000 |
| E | 0.0639 | 0.0855 | 0.1679 | 0.4613 | 0.0867 | 0.1347 | 0.0000 |
| ENE | 0.1463 | 0.1077 | 0.0842 | 0.1234 | 0.1536 | 0.3848 | 0.0000 |
| NE | 0.1549 | 0.1152 | 0.0798 | 0.0798 | 0.1348 | 0.4354 | 0.0000 |
| NNE | 0.2188 | 0.0712 | 0.0311 | 0.1117 | 0.1565 | 0.4107 | 0.0000 |
| TOTAL | 0.1909 | 0.0861 | 0.1159 | 0.2590 | 0.0997 | 0.2483 | 0.0000 |

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 10.5 degrees C
283.66 K
Precipitation: 96.1 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: 2.459 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 3.0

Clean Air Act Assessment Package - 1988

G E N E R A L  D A T A

Non-Radon Individual Assessment
May 5, 2011 01:23 pm

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

Source Category: DOE FACILITY
Source Type: Stack
Emission Year: 2010

Comments: KNOLLS 2010 EMISSIONS
MAXIMALLY EXPOSED INDIVIDUAL

Dataset Name: KNOMEI2010
Dataset Date: 5/5/2011 12:45:00 PM
Wind File: C:\Program Files\CAP88-PC30\WindLib\KAPL2010.WND

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

| Nuclide | Clearance Type | Particle Size (microns) | Scavenging Coefficient (per second) | Dry Deposition Velocity (m/s) |
|---|---|---|---|---|
| Cs-137 | F | 1 | 9.61E-06 | 1.80E-03 |
| Ba-137m | M | 1 | 9.61E-06 | 1.80E-03 |
| Sr-90 | F | 1 | 9.61E-06 | 1.80E-03 |
| Y-90 | M | 1 | 9.61E-06 | 1.80E-03 |
| Y-90 | S | 1 | 9.61E-06 | 1.80E-03 |
| Kr-85 | G | 0 | 0.00E+00 | 0.00E+00 |
| H-3 | V | 0 | 0.00E+00 | 0.00E+00 |
| Co-60 | S | 1 | 9.61E-06 | 1.80E-03 |
| Pu-238 | S | 1 | 9.61E-06 | 1.80E-03 |
| U-234 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-230 | S | 1 | 9.61E-06 | 1.80E-03 |
| Ra-226 | M | 1 | 9.61E-06 | 1.80E-03 |
| Rn-222 | G | 0 | 0.00E+00 | 0.00E+00 |
| Po-218 | M | 1 | 9.61E-06 | 1.80E-03 |
| Pb-214 | M | 1 | 9.61E-06 | 1.80E-03 |
| Bi-214 | M | 1 | 9.61E-06 | 1.80E-03 |
| Po-214 | M | 1 | 9.61E-06 | 1.80E-03 |
| Pb-210 | M | 1 | 9.61E-06 | 1.80E-03 |
| At-218 | M | 1 | 9.61E-06 | 1.80E-03 |
| U-238 | S | 1 | 9.61E-06 | 1.80E-03 |
| Th-234 | S | 1 | 9.61E-06 | 1.80E-03 |
| Pa-234m | M | 1 | 9.61E-06 | 1.80E-03 |
| Pa-234 | M | 1 | 9.61E-06 | 1.80E-03 |
| U-235 | S | 1 | 9.61E-06 | 1.80E-03 |
| Th-231 | S | 1 | 9.61E-06 | 1.80E-03 |
| Pa-231 | M | 1 | 9.61E-06 | 1.80E-03 |
| Ac-227 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-227 | S | 1 | 9.61E-06 | 1.80E-03 |
| Fr-223 | M | 1 | 9.61E-06 | 1.80E-03 |
| U-236 | S | 1 | 9.61E-06 | 1.80E-03 |
| Th-232 | S | 1 | 9.61E-06 | 1.80E-03 |
| Ra-228 | M | 1 | 9.61E-06 | 1.80E-03 |
| Ac-228 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-228 | S | 1 | 9.61E-06 | 1.80E-03 |
| U-234 | S | 1 | 9.61E-06 | 1.80E-03 |

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

| Nuclide | DECAY CONSTANT (PER DAY) Radio-active (1) | Surface | Water | TRANSFER COEFFICIENT Milk (2) | Meat (3) |
|---|---|---|---|---|---|
| Cs-137 | 6.32E-05 | 5.48E-05 | 0.00E+00 | 1.00E-02 | 5.00E-02 |
| Ba-137m | 3.91E+02 | 5.48E-05 | 0.00E+00 | 5.00E-04 | 2.00E-04 |
| Sr-90 | 6.52E-05 | 5.48E-05 | 0.00E+00 | 2.00E-03 | 1.00E-02 |
| Y-90 | 2.60E-01 | 5.48E-05 | 0.00E+00 | 6.00E-05 | 2.00E-03 |
| Y-90 | 2.60E-01 | 5.48E-05 | 0.00E+00 | 6.00E-05 | 2.00E-03 |
| Kr-85 | 1.77E-04 | 5.48E-05 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| H-3 | 1.54E-04 | 5.48E-05 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Co-60 | 3.60E-04 | 5.48E-05 | 0.00E+00 | 2.00E-03 | 3.00E-02 |
| Pu-238 | 2.16E-05 | 5.48E-05 | 0.00E+00 | 1.00E-06 | 1.00E-04 |
| U-234 | 7.76E-09 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-230 | 2.46E-08 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Ra-226 | 1.19E-06 | 5.48E-05 | 0.00E+00 | 1.00E-03 | 2.00E-03 |
| 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 | 4.00E-04 | 5.00E-03 |
| Pb-214 | 3.72E+01 | 5.48E-05 | 0.00E+00 | 3.00E-04 | 8.00E-04 |
| Bi-214 | 5.02E+01 | 5.48E-05 | 0.00E+00 | 1.00E-03 | 2.00E-03 |
| Po-214 | 3.64E+08 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 5.00E-03 |
| Pb-210 | 8.51E-05 | 5.48E-05 | 0.00E+00 | 3.00E-04 | 8.00E-04 |
| At-218 | 2.99E+04 | 5.48E-05 | 0.00E+00 | 1.00E-02 | 1.00E-02 |
| U-238 | 4.25E-13 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-234 | 2.88E-02 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Pa-234m | 8.53E+02 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 5.00E-06 |
| Pa-234 | 2.48E+00 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 5.00E-06 |
| U-235 | 2.70E-12 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-231 | 6.52E-01 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Pa-231 | 5.79E-08 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 5.00E-06 |
| Ac-227 | 8.71E-05 | 5.48E-05 | 0.00E+00 | 2.00E-06 | 2.00E-05 |
| Th-227 | 3.70E-02 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Fr-223 | 4.58E+01 | 5.48E-05 | 0.00E+00 | 8.00E-03 | 3.00E-02 |
| U-236 | 8.10E-11 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-232 | 1.35E-13 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Ra-228 | 3.30E-04 | 5.48E-05 | 0.00E+00 | 1.00E-03 | 2.00E-03 |
| Ac-228 | 2.71E+00 | 5.48E-05 | 0.00E+00 | 2.00E-06 | 2.00E-05 |
| Th-228 | 9.92E-04 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| U-234 | 7.76E-09 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |

FOOTNOTES:

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

(2) 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 |
| Cs-137 | 1.00E+00 | 2.00E-01 | 1.00E+00 | 1.00E+00 |
| Ba-137m | 1.00E-01 | 1.00E-02 | 2.00E-01 | 2.00E-01 |
| Sr-90 | 4.00E+00 | 3.00E-01 | 3.00E-01 | 3.00E-01 |
| Y-90 | 1.00E-01 | 2.00E-03 | 1.00E-04 | 1.00E-04 |
| Y-90 | 1.00E-01 | 2.00E-03 | 1.00E-04 | 1.00E-04 |
| Kr-85 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| H-3 | 0.00E+00 | 0.00E+00 | 1.00E+00 | 1.00E+00 |
| Co-60 | 2.00E+00 | 8.00E-02 | 1.00E-01 | 1.00E-01 |
| Pu-238 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| U-234 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-230 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Ra-226 | 2.00E-01 | 4.00E-02 | 2.00E-01 | 2.00E-01 |
| Rn-222 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Po-218 | 1.00E-01 | 1.00E-03 | 1.00E-01 | 1.00E-01 |
| Pb-214 | 1.00E-01 | 4.00E-03 | 2.00E-01 | 2.00E-01 |
| Bi-214 | 5.00E-01 | 1.00E-01 | 5.00E-02 | 5.00E-02 |
| Po-214 | 1.00E-01 | 1.00E-03 | 1.00E-01 | 1.00E-01 |
| Pb-210 | 1.00E-01 | 4.00E-03 | 2.00E-01 | 2.00E-01 |
| At-218 | 9.00E-01 | 2.00E-01 | 1.00E+00 | 1.00E+00 |
| U-238 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-234 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Pa-234m | 1.00E-01 | 1.00E-02 | 5.00E-04 | 5.00E-04 |
| Pa-234 | 1.00E-01 | 1.00E-02 | 5.00E-04 | 5.00E-04 |
| U-235 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-231 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Pa-231 | 1.00E-01 | 1.00E-02 | 5.00E-04 | 5.00E-04 |
| Ac-227 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Th-227 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Fr-223 | 1.00E-01 | 3.00E-02 | 1.00E+00 | 1.00E+00 |
| U-236 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-232 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Ra-228 | 2.00E-01 | 4.00E-02 | 2.00E-01 | 2.00E-01 |
| Ac-228 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Th-228 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| U-234 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |

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 ACTIVITIES

| Nuclide | Stack | Activity at 500. seconds | Activity at 100.00 years |
|---|---|---|---|
| Cs-137 | 1 | 2.9700E-06 | 1.3600E-06 |
| Ba-137m | 1 | 2.5170E-06 | 1.2860E-06 |
| Sr-90 | 1 | 2.9700E-06 | 1.3600E-06 |
| Y-90 | 1 | 4.4630E-09 | 1.3320E-06 |
| Y-90 | 1 | 2.9660E-06 | 2.3960E-08 |
| Kr-85 | 1 | 2.7500E-02 | 1.2440E-02 |
| H-3 | 1 | 1.4400E-07 | 0.0000E+00 |
| Co-60 | 1 | 2.5800E-08 | 0.0000E+00 |
| Pu-238 | 1 | 2.0800E-08 | 0.0000E+00 |
| U-234 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-230 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ra-226 | 1 | 0.0000E+00 | 0.0000E+00 |
| Rn-222 | 1 | 0.0000E+00 | 0.0000E+00 |
| Po-218 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pb-214 | 1 | 0.0000E+00 | 0.0000E+00 |
| Bi-214 | 1 | 0.0000E+00 | 0.0000E+00 |
| Po-214 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pb-210 | 1 | 0.0000E+00 | 0.0000E+00 |
| At-218 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-238 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-234 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pa-234m | 1 | 0.0000E+00 | 0.0000E+00 |
| Pa-234 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-235 | 1 | 1.0300E-08 | 0.0000E+00 |
| Th-231 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pa-231 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ac-227 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-227 | 1 | 0.0000E+00 | 0.0000E+00 |
| Fr-223 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-236 | 1 | 1.9100E-09 | 0.0000E+00 |
| Th-232 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ra-228 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ac-228 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-228 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-234 | 1 | 6.1500E-07 | 2.8350E-07 |

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+02 |
| 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 | 4.40E-01 |
| Milk | 4.00E-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 |

# Diffuse Source

# CAP88-PC

# Calculation

C A P 88 - 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
May 25, 2011 02:37 pm

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

Source Category: DIFFUSE SOURCE
Source Type: Area
Emission Year: 2010

Comments: MEI EVALUATION 2010
CONTAMINATED SOIL

| Effective Dose Equivalent (mrem/year) |
|---|
| 3.34E-05 |

At This Location: 450 Meters South Southwest

Dataset Name: KNO2010SOIL
Dataset Date: 5/25/2011 2:32:00 PM
Wind File: C:\Program Files\CAP88-PC30\WindLib\KAPL2010

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters South Southwest
Lifetime Fatal Cancer Risk: 1.82E-11

ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Dose Equivalent (mrem/y) |
|---|---|
| Adrenals | 6.52E-07 |
| B Surfac | 3.98E-04 |
| Breasts | 6.54E-07 |
| St Wall | 8.80E-07 |
| ULI Wall | 5.61E-06 |
| Kidneys | 6.76E-07 |
| Lungs | 2.08E-06 |
| Ovaries | 7.66E-07 |
| R Marrow | 1.72E-04 |
| Spleen | 6.52E-07 |
| Thymus | 6.53E-07 |
| Uterus | 6.52E-07 |
| Bld Wall | 1.44E-06 |
| Brain | 6.52E-07 |
| Esophagu | 1.23E-06 |
| SI Wall | 1.10E-06 |
| LLI Wall | 2.09E-05 |
| Liver | 1.49E-06 |
| Muscle | 6.53E-07 |
| Pancreas | 6.52E-07 |
| Skin | 9.28E-06 |
| Testes | 7.68E-07 |
| Thyroid | 6.53E-07 |
| EFFEC | 3.34E-05 |

RADIONUCLIDE EMISSIONS DURING THE YEAR 2010

| Nuclide | Type | Size | Source #1 Ci/y | TOTAL Ci/y |
|---|---|---|---|---|
| Sr-90 | F | 1 | 8.6E-07 | 8.6E-07 |
| Y-90 | M | 1 | 8.6E-07 | 8.6E-07 |
| Cs-137 | F | 1 | 7.8E-09 | 7.8E-09 |
| Ba-137m | M | 1 | 7.8E-09 | 7.8E-09 |
| Am-241 | M | 1 | 3.2E-09 | 3.2E-09 |
| Pu-238 | S | 1 | 3.2E-10 | 3.2E-10 |
| Pu-239 | S | 1 | 1.3E-08 | 1.3E-08 |
| Pu-240 | S | 1 | 3.2E-09 | 3.2E-09 |
| Pu-241 | S | 1 | 6.5E-09 | 6.5E-09 |
| Pu-242 | S | 1 | 3.2E-13 | 3.2E-13 |

SITE INFORMATION

| | | |
|---|---|---|
| Temperature: | 11 | degrees C |
| Precipitation: | 96 | cm/y |
| Humidity: | 8 | g/cu m |
| Mixing Height: | 1000 | m |

User specified location of max exposed individual.
(ILOC, JLOC): 8, 1

SOURCE INFORMATION

Source Number: 1

Source Height (m): 1.00
Area (sq m): 9547.00

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 | 80000 | | |

C A P 88 - 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
May 25, 2011 02:37 pm

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

Source Category: DIFFUSE SOURCE
Source Type: Area
Emission Year: 2010

Comments: MEI EVALUATION 2010
CONTAMINATED SOIL

Dataset Name: KNO2010SOIL
Dataset Date: 5/25/2011 2:32:00 PM
Wind File: . C:\Program Files\CAP88-PC30\WindLib\KAPL2010.WND

## ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Selected Individual (mrem/y) |
|---|---|
| Adrenals | 6.52E-07 |
| B Surfac | 3.98E-04 |
| Breasts | 6.54E-07 |
| St Wall | 8.80E-07 |
| ULI Wall | 5.61E-06 |
| Kidneys | 6.76E-07 |
| Lungs | 2.08E-06 |
| Ovaries | 7.66E-07 |
| R Marrow | 1.72E-04 |
| Spleen | 6.52E-07 |
| Thymus | 6.53E-07 |
| Uterus | 6.52E-07 |
| Bld Wall | 1.44E-06 |
| Brain | 6.52E-07 |
| Esophagu | 1.23E-06 |
| SI Wall | 1.10E-06 |
| LLI Wall | 2.09E-05 |
| Liver | 1.49E-06 |
| Muscle | 6.53E-07 |
| Pancreas | 6.52E-07 |
| Skin | 9.28E-06 |
| Testes | 7.68E-07 |
| Thyroid | 6.53E-07 |
| EFFEC | 3.34E-05 |

## PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

| Pathway | Selected Individual (mrem/y) |
|---|---|
| INGESTION | 2.61E-05 |
| INHALATION | 7.24E-06 |
| AIR IMMERSION | 6.59E-11 |
| GROUND SURFACE | 9.05E-08 |
| INTERNAL | 3.33E-05 |
| EXTERNAL | 9.06E-08 |
| TOTAL | 3.34E-05 |

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

| Nuclide | Selected Individual (mrem/y) |
|---|---|
| Sr-90 | 2.65E-05 |
| Y-90 | 1.11E-07 |
| Cs-137 | 6.30E-10 |
| Ba-137m | 1.35E-11 |
| Pu-238 | 0.00E+00 |
| U-234 | 0.00E+00 |
| Th-230 | 0.00E+00 |
| Ra-226 | 0.00E+00 |
| Rn-222 | 0.00E+00 |
| Pu-239 | 3.61E-06 |
| U-235 | 0.00E+00 |
| Th-231 | 0.00E+00 |
| Pa-231 | 0.00E+00 |
| Ac-227 | 0.00E+00 |
| Pu-240 | 8.96E-07 |
| U-236 | 0.00E+00 |
| Th-232 | 0.00E+00 |
| Ra-228 | 0.00E+00 |
| Ac-228 | 0.00E+00 |
| Pu-241 | 1.98E-08 |
| Am-241 | 2.33E-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 |
| Pu-242 | 0.00E+00 |
| U-238 | 0.00E+00 |
| Th-234 | 0.00E+00 |
| Pa-234m | 0.00E+00 |
| Pa-234 | 0.00E+00 |
| TOTAL | 3.34E-05 |

CANCER RISK SUMMARY

| Cancer | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Esophagu | 1.22E-14 |
| Stomach | 6.01E-14 |
| Colon | 2.13E-12 |
| Liver | 1.72E-13 |
| LUNG | 2.57E-12 |
| Bone | 6.39E-13 |
| Skin | 9.79E-15 |
| Breast | 5.44E-14 |
| Ovary | 3.30E-14 |
| Bladder | 5.25E-14 |
| Kidneys | 7.90E-15 |
| Thyroid | 3.88E-15 |
| Leukemia | 1.23E-11 |
| Residual | 1.79E-13 |
| Total | 1.82E-11 |
| TOTAL | 3.65E-11 |

PATHWAY RISK SUMMARY

| Pathway | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| INGESTION | 1.53E-11 |
| INHALATION | 2.93E-12 |
| AIR IMMERSION | 1.72E-17 |
| GROUND SURFACE | 1.08E-14 |
| INTERNAL | 1.82E-11 |
| EXTERNAL | 1.09E-14 |
| TOTAL | 1.82E-11 |

NUCLIDE RISK SUMMARY

| Nuclide | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Sr-90 | 1.54E-11 |
| Y-90 | 3.40E-14 |
| Cs-137 | 2.95E-16 |
| Ba-137m | 7.40E-18 |
| Pu-238 | 0.00E+00 |
| U-234 | 0.00E+00 |
| Th-230 | 0.00E+00 |
| Ra-226 | 0.00E+00 |
| Rn-222 | 0.00E+00 |
| Pu-239 | 1.90E-12 |
| U-235 | 0.00E+00 |
| Th-231 | 0.00E+00 |
| Pa-231 | 0.00E+00 |
| Ac-227 | 0.00E+00 |
| Pu-240 | 4.73E-13 |
| U-236 | 0.00E+00 |
| Th-232 | 0.00E+00 |
| Ra-228 | 0.00E+00 |
| Ac-228 | 0.00E+00 |
| Pu-241 | 3.97E-15 |
| Am-241 | 3.68E-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 |
| Pu-242 | 0.00E+00 |
| U-238 | 0.00E+00 |
| Th-234 | 0.00E+00 |
| Pa-234m | 0.00E+00 |
| Pa-234 | 0.00E+00 |
| TOTAL | 1.82E-11 |

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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 450 | 550 | 700 | 750 | 775 | 950 | 1000 |
| N | 3.3E-05 | 2.4E-05 | 1.7E-05 | 1.5E-05 | 1.4E-05 | 1.1E-05 | 1.1E-05 |
| NNW | 4.1E-05 | 2.9E-05* | 2.0E-05 | 1.8E-05 | 1.7E-05 | 1.3E-05 | 1.2E-05 |
| NW | 1.7E-05 | 1.3E-05 | 9.6E-06* | 8.9E-06 | 8.7E-06 | 7.3E-06 | 7.0E-06 |
| WNW | 1.3E-05 | 9.9E-06 | 7.9E-06 | 7.4E-06 | 7.2E-06* | 6.3E-06 | 6.1E-06 |
| W | 1.4E-05 | 1.1E-05 | 8.4E-06 | 7.9E-06 | 7.7E-06 | 6.6E-06 | 6.4E-06 |
| WSW | 1.2E-05 | 9.7E-06 | 7.7E-06 | 7.3E-06 | 7.1E-06 | 6.2E-06 | 6.0E-06 |
| SW | 2.6E-05 | 1.9E-05 | 1.4E-05 | 1.3E-05 | 1.2E-05 | 9.7E-06 | 9.2E-06 |
| SSW | 3.3E-05 | 2.4E-05 | 1.7E-05 | 1.5E-05 | 1.5E-05 | 1.1E-05 | 1.1E-05 |
| S | 2.7E-05 | 1.9E-05 | 1.4E-05 | 1.3E-05 | 1.2E-05 | 9.5E-06 | 9.0E-06 |
| SSE | 3.4E-05 | 2.5E-05 | 1.7E-05 | 1.5E-05 | 1.5E-05 | 1.1E-05 | 1.1E-05 |
| SE | 4.0E-05 | 2.9E-05 | 2.0E-05 | 1.8E-05 | 1.7E-05 | 1.3E-05 | 1.2E-05 |
| ESE | 4.9E-05 | 3.5E-05 | 2.4E-05 | 2.2E-05 | 2.1E-05 | 1.6E-05 | 1.5E-05 |
| E | 2.8E-05 | 2.0E-05 | 1.4E-05 | 1.3E-05 | 1.3E-05 | 1.0E-05 | 9.5E-06 |
| ENE | 2.0E-05 | 1.5E-05 | 1.1E-05 | 9.9E-06 | 9.6E-06 | 7.9E-06 | 7.5E-06 |
| NE | 1.8E-05 | 1.3E-05 | 9.9E-06 | 9.2E-06 | 8.9E-06 | 7.4E-06 | 7.1E-06 |
| NNE | 1.9E-05 | 1.4E-05 | 1.1E-05 | 9.9E-06 | 9.5E-06 | 7.8E-06 | 7.5E-06 |

| | Distance (m) | | | | |
|---|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 | 80000 |
| N | 1.0E-05 | 8.3E-06 | 7.0E-06 | 5.6E-06 | 4.2E-06 |
| NNW | 1.2E-05 | 9.5E-06 | 7.8E-06 | 6.0E-06 | 4.2E-06 |
| NW | 6.8E-06 | 6.0E-06 | 5.4E-06 | 4.8E-06 | 4.2E-06 |
| WNW | 6.0E-06 | 5.5E-06 | 5.1E-06 | 4.6E-06 | 4.2E-06 |
| W | 6.2E-06 | 5.6E-06 | 5.2E-06 | 4.7E-06 | 4.2E-06 |
| WSW | 5.9E-06 | 5.4E-06 | 5.0E-06 | 4.6E-06 | 4.2E-06 |
| SW | 8.8E-06 | 7.5E-06 | 6.4E-06 | 5.3E-06 | 4.2E-06 |
| SSW | 1.0E-05 | 8.3E-06 | 6.9E-06 | 5.5E-06 | 4.2E-06 |
| S | 8.6E-06 | 7.2E-06 | 6.2E-06 | 5.2E-06 | 4.2E-06 |
| SSE | 1.0E-05 | 8.3E-06 | 6.9E-06 | 5.5E-06 | 4.2E-06 |
| SE | 1.1E-05 | 9.3E-06 | 7.6E-06 | 5.9E-06 | 4.2E-06 |
| ESE | 1.4E-05 | 1.1E-05 | 8.8E-06 | 6.5E-06 | 4.3E-06 |
| E | 9.1E-06 | 7.6E-06 | 6.5E-06 | 5.4E-06 | 4.2E-06 |
| ENE | 7.2E-06 | 6.3E-06 | 5.6E-06 | 4.9E-06 | 4.2E-06 |
| NE | 6.9E-06 | 6.1E-06 | 5.5E-06 | 4.8E-06 | 4.2E-06 |
| NNE | 7.2E-06 | 6.3E-06 | 5.6E-06 | 4.9E-06 | 4.2E-06 |

* 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 | 1.8E-11 | 1.3E-11 | 9.1E-12 | 8.3E-12 | 8.0E-12 | 6.2E-12 | 5.9E-12 |
| NNW | 2.2E-11 | 1.6E-11 | 1.1E-11 | 1.0E-11 | 9.5E-12 | 7.3E-12 | 6.9E-12 |
| NW | 9.2E-12 | 7.1E-12 | 5.4E-12 | 5.0E-12 | 4.9E-12 | 4.1E-12 | 4.0E-12 |
| WNW | 7.0E-12 | 5.6E-12 | 4.5E-12 | 4.2E-12 | 4.1E-12 | 3.6E-12 | 3.5E-12 |
| W | 7.7E-12 | 6.0E-12 | 4.7E-12 | 4.5E-12 | 4.3E-12 | 3.8E-12 | 3.6E-12 |
| WSW | 6.8E-12 | 5.4E-12 | 4.4E-12 | 4.1E-12 | 4.0E-12 | 3.6E-12 | 3.5E-12 |
| SW | 1.4E-11 | 1.1E-11 | 7.7E-12 | 7.1E-12 | 6.8E-12 | 5.5E-12 | 5.2E-12 |
| SSW | 1.8E-11 | 1.3E-11 | 9.2E-12 | 8.4E-12 | 8.0E-12 | 6.3E-12 | 5.9E-12 |
| S | 1.5E-11 | 1.1E-11 | 7.6E-12 | 7.0E-12 | 6.7E-12 | 5.3E-12 | 5.0E-12 |
| SSE | 1.9E-11 | 1.4E-11 | 9.4E-12 | 8.5E-12 | 8.2E-12 | 6.3E-12 | 6.0E-12 |
| SE | 2.2E-11 | 1.6E-11 | 1.1E-11 | 9.8E-12 | 9.4E-12 | 7.2E-12 | 6.7E-12 |
| ESE | 2.7E-11 | 1.9E-11 | 1.3E-11 | 1.2E-11 | 1.1E-11 | 8.7E-12 | 8.1E-12 |
| E | 1.5E-11 | 1.1E-11 | 8.0E-12 | 7.3E-12 | 7.0E-12 | 5.6E-12 | 5.3E-12 |
| ENE | 1.1E-11 | 8.1E-12 | 6.0E-12 | 5.6E-12 | 5.4E-12 | 4.4E-12 | 4.3E-12 |
| NE | 9.7E-12 | 7.4E-12 | 5.6E-12 | 5.2E-12 | 5.0E-12 | 4.2E-12 | 4.0E-12 |
| NNE | 1.1E-11 | 8.0E-12 | 6.0E-12 | 5.5E-12 | 5.3E-12 | 4.4E-12 | 4.2E-12 |

| | Distance (m) | | | | |
|---|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 | 80000 |
| N | 5.6E-12 | 4.7E-12 | 4.0E-12 | 3.2E-12 | 2.5E-12 |
| NNW | 6.5E-12 | 5.3E-12 | 4.4E-12 | 3.4E-12 | 2.5E-12 |
| NW | 3.9E-12 | 3.4E-12 | 3.1E-12 | 2.8E-12 | 2.5E-12 |
| WNW | 3.4E-12 | 3.1E-12 | 2.9E-12 | 2.7E-12 | 2.5E-12 |
| W | 3.5E-12 | 3.2E-12 | 3.0E-12 | 2.7E-12 | 2.5E-12 |
| WSW | 3.4E-12 | 3.1E-12 | 2.9E-12 | 2.7E-12 | 2.5E-12 |
| SW | 5.0E-12 | 4.2E-12 | 3.7E-12 | 3.1E-12 | 2.5E-12 |
| SSW | 5.6E-12 | 4.7E-12 | 3.9E-12 | 3.2E-12 | 2.5E-12 |
| S | 4.8E-12 | 4.1E-12 | 3.6E-12 | 3.0E-12 | 2.5E-12 |
| SSE | 5.7E-12 | 4.7E-12 | 4.0E-12 | 3.2E-12 | 2.5E-12 |
| SE | 6.4E-12 | 5.2E-12 | 4.3E-12 | 3.4E-12 | 2.5E-12 |
| ESE | 7.7E-12 | 6.2E-12 | 5.0E-12 | 3.7E-12 | 2.5E-12 |
| E | 5.1E-12 | 4.3E-12 | 3.7E-12 | 3.1E-12 | 2.5E-12 |
| ENE | 4.1E-12 | 3.6E-12 | 3.2E-12 | 2.8E-12 | 2.5E-12 |
| NE | 3.9E-12 | 3.5E-12 | 3.1E-12 | 2.8E-12 | 2.5E-12 |
| NNE | 4.1E-12 | 3.6E-12 | 3.2E-12 | 2.8E-12 | 2.5E-12 |

C A P 88 - 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
May 25, 2011  02:37 pm

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

Source Category: DIFFUSE SOURCE
Source Type: Area
Emission Year: 2010

Comments: MEI EVALUATION 2010
CONTAMINATED SOIL

Dataset Name: KNO2010SOIL
Dataset Date: 5/25/2011 2:32:00 PM
Wind File: C:\Program Files\CAP88-PC30\WindLib\KAPL2010.WND

May 25, 2011 02:37 pm WEATHER
Page 1

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G | Wind Freq |
| N | 1.351 | 1.830 | 2.140 | 1.622 | 1.115 | 0.859 | 0.000 | 0.069 |
| NNW | 1.236 | 1.520 | 2.902 | 2.560 | 1.162 | 1.090 | 0.000 | 0.097 |
| NW | 0.886 | 1.741 | 4.373 | 2.625 | 0.982 | 0.855 | 0.000 | 0.030 |
| WNW | 0.823 | 1.026 | 1.052 | 1.312 | 0.772 | 0.808 | 0.000 | 0.024 |
| W | 0.778 | 0.824 | 0.862 | 1.325 | 0.834 | 0.792 | 0.000 | 0.022 |
| WSW | 0.792 | 0.935 | 1.078 | 1.952 | 0.806 | 0.772 | 0.000 | 0.023 |
| SW | 0.899 | 1.508 | 1.758 | 2.569 | 1.448 | 0.929 | 0.000 | 0.069 |
| SSW | 0.899 | 1.587 | 3.410 | 4.172 | 1.782 | 0.917 | 0.000 | 0.054 |
| S | 0.839 | 1.187 | 0.000 | 2.572 | 0.931 | 0.794 | 0.000 | 0.031 |
| SSE | 0.978 | 1.067 | 0.998 | 0.908 | 0.879 | 0.806 | 0.000 | 0.044 |
| SE | 1.134 | 2.062 | 3.069 | 2.317 | 1.039 | 0.866 | 0.000 | 0.079 |
| ESE | 1.344 | 2.900 | 4.286 | 3.796 | 1.498 | 0.938 | 0.000 | 0.279 |
| E | 1.286 | 2.483 | 4.484 | 3.667 | 1.430 | 0.875 | 0.000 | 0.101 |
| ENE | 1.066 | 2.307 | 4.054 | 2.781 | 1.187 | 0.806 | 0.000 | 0.030 |
| NE | 1.027 | 1.952 | 2.679 | 1.130 | 1.007 | 0.797 | 0.000 | 0.023 |
| NNE | 0.948 | 1.826 | 1.539 | 1.221 | 0.965 | 0.789 | 0.000 | 0.026 |

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 1.875 | 2.677 | 3.373 | 2.525 | 1.574 | 1.033 | 0.000 |
| NNW | 1.737 | 2.315 | 4.086 | 3.519 | 1.688 | 1.522 | 0.000 |
| NW | 1.103 | 2.362 | 4.373 | 3.335 | 1.393 | 1.022 | 0.000 |
| WNW | 0.932 | 1.409 | 1.937 | 2.572 | 0.772 | 0.888 | 0.000 |
| W | 0.792 | 0.936 | 1.143 | 1.846 | 0.964 | 0.837 | 0.000 |
| WSW | 0.837 | 1.222 | 1.574 | 3.472 | 0.880 | 0.772 | 0.000 |
| SW | 1.137 | 2.171 | 2.684 | 3.191 | 1.973 | 1.208 | 0.000 |
| SSW | 1.136 | 2.415 | 3.646 | 4.249 | 2.410 | 1.180 | 0.000 |
| S | 0.978 | 1.672 | 0.000 | 2.572 | 1.212 | 0.845 | 0.000 |
| SSE | 1.314 | 1.593 | 1.354 | 1.429 | 1.157 | 0.882 | 0.000 |
| SE | 1.594 | 2.913 | 4.115 | 3.397 | 1.463 | 1.053 | 0.000 |
| ESE | 1.867 | 3.351 | 4.565 | 4.398 | 2.019 | 1.227 | 0.000 |
| E | 1.801 | 3.197 | 4.712 | 4.495 | 1.956 | 1.076 | 0.000 |
| ENE | 1.482 | 2.959 | 4.242 | 3.730 | 1.672 | 0.880 | 0.000 |
| NE | 1.411 | 2.647 | 3.251 | 1.822 | 1.372 | 0.855 | 0.000 |
| NNE | 1.249 | 2.346 | 2.055 | 1.775 | 1.287 | 0.830 | 0.000 |

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 0.1848 | 0.1415 | 0.0348 | 0.1813 | 0.2163 | 0.2414 | 0.0000 |
| NNW | 0.2264 | 0.1073 | 0.0755 | 0.1451 | 0.1344 | 0.3113 | 0.0000 |
| NW | 0.5214 | 0.0344 | 0.0191 | 0.0458 | 0.0765 | 0.3028 | 0.0000 |
| WNW | 0.6465 | 0.0814 | 0.0142 | 0.0092 | 0.0288 | 0.2199 | 0.0000 |
| W | 0.4504 | 0.1151 | 0.0731 | 0.0260 | 0.0471 | 0.2883 | 0.0000 |
| WSW | 0.4021 | 0.0787 | 0.0979 | 0.1861 | 0.0783 | 0.1570 | 0.0000 |
| SW | 0.3378 | 0.1204 | 0.1054 | 0.1120 | 0.1103 | 0.2141 | 0.0000 |
| SSW | 0.3454 | 0.0486 | 0.0105 | 0.0296 | 0.0699 | 0.4960 | 0.0000 |
| S | 0.3506 | 0.0070 | 0.0000 | 0.0035 | 0.0143 | 0.6245 | 0.0000 |
| SSE | 0.2685 | 0.0338 | 0.0077 | 0.0286 | 0.1092 | 0.5521 | 0.0000 |
| SE | 0.1337 | 0.0770 | 0.0756 | 0.2443 | 0.1439 | 0.3255 | 0.0000 |
| ESE | 0.0379 | 0.0848 | 0.2343 | 0.5068 | 0.0630 | 0.0733 | 0.0000 |
| E | 0.0639 | 0.0855 | 0.1679 | 0.4613 | 0.0867 | 0.1347 | 0.0000 |
| ENE | 0.1463 | 0.1077 | 0.0842 | 0.1234 | 0.1536 | 0.3848 | 0.0000 |
| NE | 0.1549 | 0.1152 | 0.0798 | 0.0798 | 0.1348 | 0.4354 | 0.0000 |
| NNE | 0.2188 | 0.0712 | 0.0311 | 0.1117 | 0.1565 | 0.4107 | 0.0000 |
| TOTAL | 0.1909 | 0.0861 | 0.1159 | 0.2590 | 0.0997 | 0.2483 | 0.0000 |

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 10.5 degrees C
283.66 K
Precipitation: 96.1 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: 2.459 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 88 - P C

Version 3.0

Clean Air Act Assessment Package - 1988

G E N E R A L  D A T A

Non-Radon Individual Assessment
May 25, 2011  02:37 pm

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

Source Category: DIFFUSE SOURCE
Source Type: Area
Emission Year: 2010

Comments: MEI EVALUATION 2010
CONTAMINATED SOIL

Dataset Name: KNO2010SOIL
Dataset Date: 5/25/2011 2:32:00 PM
Wind File: C:\Program Files\CAP88-PC30\WindLib\KAPL2010.WND

VALUES FOR RADIONUCLIDE-DEPENDENT PARAMETERS

| Nuclide | Clearance Type | Particle Size (microns) | Scavenging Coefficient (per second) | Dry Deposition Velocity (m/s) |
|---|---|---|---|---|
| Sr-90 | F | 1 | 9.61E-06 | 1.80E-03 |
| Y-90 | M | 1 | 9.61E-06 | 1.80E-03 |
| Cs-137 | F | 1 | 9.61E-06 | 1.80E-03 |
| Ba-137m | M | 1 | 9.61E-06 | 1.80E-03 |
| Pu-238 | S | 1 | 9.61E-06 | 1.80E-03 |
| U-234 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-230 | S | 1 | 9.61E-06 | 1.80E-03 |
| Ra-226 | M | 1 | 9.61E-06 | 1.80E-03 |
| Rn-222 | G | 0 | 0.00E+00 | 0.00E+00 |
| Pu-239 | S | 1 | 9.61E-06 | 1.80E-03 |
| U-235 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-231 | S | 1 | 9.61E-06 | 1.80E-03 |
| Pa-231 | M | 1 | 9.61E-06 | 1.80E-03 |
| Ac-227 | M | 1 | 9.61E-06 | 1.80E-03 |
| Pu-240 | S | 1 | 9.61E-06 | 1.80E-03 |
| U-236 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-232 | S | 1 | 9.61E-06 | 1.80E-03 |
| Ra-228 | M | 1 | 9.61E-06 | 1.80E-03 |
| Ac-228 | M | 1 | 9.61E-06 | 1.80E-03 |
| Pu-241 | S | 1 | 9.61E-06 | 1.80E-03 |
| Am-241 | M | 1 | 9.61E-06 | 1.80E-03 |
| Np-237 | M | 1 | 9.61E-06 | 1.80E-03 |
| Pa-233 | M | 1 | 9.61E-06 | 1.80E-03 |
| U-233 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-229 | S | 1 | 9.61E-06 | 1.80E-03 |
| U-237 | M | 1 | 9.61E-06 | 1.80E-03 |
| Pu-242 | S | 1 | 9.61E-06 | 1.80E-03 |
| U-238 | M | 1 | 9.61E-06 | 1.80E-03 |
| Th-234 | S | 1 | 9.61E-06 | 1.80E-03 |
| Pa-234m | M | 1 | 9.61E-06 | 1.80E-03 |
| Pa-234 | M | 1 | 9.61E-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) |
| Sr-90 | 6.52E-05 | 5.48E-05 | 0.00E+00 | 2.00E-03 | 1.00E-02 |
| Y-90 | 2.60E-01 | 5.48E-05 | 0.00E+00 | 6.00E-05 | 2.00E-03 |
| Cs-137 | 6.32E-05 | 5.48E-05 | 0.00E+00 | 1.00E-02 | 5.00E-02 |
| Ba-137m | 3.91E+02 | 5.48E-05 | 0.00E+00 | 5.00E-04 | 2.00E-04 |
| Pu-238 | 2.16E-05 | 5.48E-05 | 0.00E+00 | 1.00E-06 | 1.00E-04 |
| U-234 | 7.76E-09 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-230 | 2.46E-08 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Ra-226 | 1.19E-06 | 5.48E-05 | 0.00E+00 | 1.00E-03 | 2.00E-03 |
| Rn-222 | 1.81E-01 | 5.48E-05 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Pu-239 | 7.88E-08 | 5.48E-05 | 0.00E+00 | 1.00E-06 | 1.00E-04 |
| U-235 | 2.70E-12 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-231 | 6.52E-01 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Pa-231 | 5.79E-08 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 5.00E-06 |
| Ac-227 | 8.71E-05 | 5.48E-05 | 0.00E+00 | 2.00E-06 | 2.00E-05 |
| Pu-240 | 2.90E-07 | 5.48E-05 | 0.00E+00 | 1.00E-06 | 1.00E-04 |
| U-236 | 8.10E-11 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-232 | 1.35E-13 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Ra-228 | 3.30E-04 | 5.48E-05 | 0.00E+00 | 1.00E-03 | 2.00E-03 |
| Ac-228 | 2.71E+00 | 5.48E-05 | 0.00E+00 | 2.00E-06 | 2.00E-05 |
| Pu-241 | 1.32E-04 | 5.48E-05 | 0.00E+00 | 1.00E-06 | 1.00E-04 |
| Am-241 | 4.39E-06 | 5.48E-05 | 0.00E+00 | 2.00E-06 | 5.00E-05 |
| Np-237 | 8.87E-10 | 5.48E-05 | 0.00E+00 | 1.00E-05 | 1.00E-03 |
| Pa-233 | 2.57E-02 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 5.00E-06 |
| U-233 | 1.20E-08 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-229 | 2.58E-07 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| U-237 | 1.03E-01 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Pu-242 | 5.04E-09 | 5.48E-05 | 0.00E+00 | 1.00E-06 | 1.00E-04 |
| U-238 | 4.25E-13 | 5.48E-05 | 0.00E+00 | 4.00E-04 | 8.00E-04 |
| Th-234 | 2.88E-02 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 1.00E-04 |
| Pa-234m | 8.53E+02 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 5.00E-06 |
| Pa-234 | 2.48E+00 | 5.48E-05 | 0.00E+00 | 5.00E-06 | 5.00E-06 |

FOOTNOTES:

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

(2) 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 |
| Sr-90 | 4.00E+00 | 3.00E-01 | 3.00E-01 | 3.00E-01 |
| Y-90 | 1.00E-01 | 2.00E-03 | 1.00E-04 | 1.00E-04 |
| Cs-137 | 1.00E+00 | 2.00E-01 | 1.00E+00 | 1.00E+00 |
| Ba-137m | 1.00E-01 | 1.00E-02 | 2.00E-01 | 2.00E-01 |
| Pu-238 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| U-234 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-230 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Ra-226 | 2.00E-01 | 4.00E-02 | 2.00E-01 | 2.00E-01 |
| Rn-222 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Pu-239 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| U-235 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-231 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Pa-231 | 1.00E-01 | 1.00E-02 | 5.00E-04 | 5.00E-04 |
| Ac-227 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Pu-240 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| U-236 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-232 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Ra-228 | 2.00E-01 | 4.00E-02 | 2.00E-01 | 2.00E-01 |
| Ac-228 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Pu-241 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Am-241 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Np-237 | 1.00E-01 | 2.00E-02 | 5.00E-04 | 5.00E-04 |
| Pa-233 | 1.00E-01 | 1.00E-02 | 5.00E-04 | 5.00E-04 |
| U-233 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-229 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| U-237 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Pu-242 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| U-238 | 1.00E-01 | 2.00E-03 | 2.00E-02 | 2.00E-02 |
| Th-234 | 1.00E-01 | 1.00E-03 | 5.00E-04 | 5.00E-04 |
| Pa-234m | 1.00E-01 | 1.00E-02 | 5.00E-04 | 5.00E-04 |
| Pa-234 | 1.00E-01 | 1.00E-02 | 5.00E-04 | 5.00E-04 |

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 ACTIVITIES

| Nuclide | Stack | Activity at 500. seconds | Activity at 100.00 years |
|---|---|---|---|
| Sr-90 | 1 | 8.6000E-07 | 3.9370E-07 |
| Y-90 | 1 | 8.6000E-07 | 3.9380E-07 |
| Cs-137 | 1 | 7.7800E-09 | 0.0000E+00 |
| Ba-137m | 1 | 7.4040E-09 | 0.0000E+00 |
| Pu-238 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-234 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-230 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ra-226 | 1 | 0.0000E+00 | 0.0000E+00 |
| Rn-222 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pu-239 | 1 | 1.3000E-08 | 0.0000E+00 |
| U-235 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-231 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pa-231 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ac-227 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pu-240 | 1 | 3.2200E-09 | 0.0000E+00 |
| U-236 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-232 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ra-228 | 1 | 0.0000E+00 | 0.0000E+00 |
| Ac-228 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pu-241 | 1 | 6.5300E-09 | 0.0000E+00 |
| Am-241 | 1 | 3.2200E-09 | 0.0000E+00 |
| Np-237 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pa-233 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-233 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-229 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-237 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pu-242 | 1 | 0.0000E+00 | 0.0000E+00 |
| U-238 | 1 | 0.0000E+00 | 0.0000E+00 |
| Th-234 | 1 | 0.0000E+00 | 0.0000E+00 |
| Pa-234m | 1 | 0.0000E+00 | 0.0000E+00 |
| Pa-234 | 1 | 0.0000E+00 | 0.0000E+00 |

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+02 |
| 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 | 4.40E-01 |
| Milk | 4.00E-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**

**2010 Annual Release**

**Distance to Maximally Exposed Individual: 450 m in the SSW sector**

**CAP88-PC Calculated Dose Equivalent: 6.3E-02 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 the Arcview GIS software. The distance and direction to the maximally exposed individual is 450 m in the south-southwest sector. The 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.

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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
Jun 21, 2011 08:31 am

Facility: aRc 2010
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Non-Point Release
Source Type: Area
Emission Year: 2010

Comments: aRc 2010 releases
Lower Level and North Field

| Effective Dose Equivalent (mrem/year) |
|---|
| 6.29E-02 |

At This Location: 450 Meters South Southwest

Dataset Name: arc2010b
Dataset Date: 6/21/2011 8:31:00 AM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL201

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters South Southwest
Lifetime Fatal Cancer Risk: 1.14E-08

ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Dose Equivalent (mrem/y) |
|---|---|
| Adrenals | 1.94E-04 |
| B Surfac | 9.66E-02 |
| Breasts | 1.90E-04 |
| St Wall | 1.95E-04 |
| ULI Wall | 2.19E-04 |
| Kidneys | 4.62E-04 |
| Lungs | 2.90E-03 |
| Ovaries | 1.29E-03 |
| R Marrow | 5.26E-03 |
| Spleen | 1.94E-04 |
| Thymus | 1.93E-04 |
| Uterus | 1.95E-04 |
| Bld Wall | 1.99E-04 |
| Brain | 1.91E-04 |
| Esophagu | 7.52E-04 |
| SI Wall | 1.97E-04 |
| LLI Wall | 2.92E-04 |
| Liver | 1.94E-02 |
| Muscle | 1.92E-04 |
| Pancreas | 1.95E-04 |
| Skin | 2.31E-04 |
| Testes | 1.31E-03 |
| Thyroid | 1.93E-04 |
| EFFEC | 6.29E-02 |

RADIONUCLIDE EMISSIONS DURING THE YEAR 2010

| Nuclide | Type | Size | Source #1 Ci/y | Source #2 Ci/y | TOTAL Ci/y |
|---|---|---|---|---|---|
| Cs-137 | F | 1 | 7.5E-07 | 3.8E-05 | 3.9E-05 |
| Ba-137m | M | 1 | 7.5E-07 | 3.8E-05 | 3.9E-05 |
| Pu-238 | M | 1 | 2.2E-07 | 1.9E-06 | 2.1E-06 |
| Pu-239 | M | 1 | 1.2E-06 | 3.1E-05 | 3.3E-05 |
| Pu-240 | M | 1 | 1.2E-06 | 3.1E-05 | 3.3E-05 |
| U-234 | M | 1 | 4.0E-06 | 2.5E-05 | 2.9E-05 |
| U-235 | M | 1 | 2.1E-07 | 1.7E-06 | 1.9E-06 |
| U-238 | M | 1 | 4.0E-07 | 3.2E-06 | 3.6E-06 |
| Bi-212 | M | 1 | 8.3E-07 | 3.2E-06 | 4.0E-06 |
| Po-212 | M | 1 | 0.0E+00 | 0.0E+00 | 0.0E+00 |
| Tl-208 | M | 1 | 4.1E-07 | 2.3E-06 | 2.7E-06 |
| Pb-212 | M | 1 | 1.0E-06 | 5.7E-06 | 6.7E-06 |
| Pb-214 | M | 1 | 1.0E-06 | 5.2E-06 | 6.2E-06 |
| 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 | 2.8E-06 | 9.3E-06 | 1.2E-05 |
| Y-90 | M | 1 | 2.8E-06 | 9.3E-06 | 1.2E-05 |
| Pu-241 | M | 1 | 5.0E-06 | 2.7E-05 | 3.2E-05 |
| Am-241 | M | 1 | 3.0E-07 | 1.8E-06 | 2.2E-06 |

SITE INFORMATION

| | | |
|---|---|---|
| Temperature: | 11 | degrees C |
| Precipitation: | 96 | cm/y |
| Humidity: | 8 | g/cu m |
| Mixing Height: | 1000 | m |

User specified location of max exposed individual.
(ILOC, JLOC): 8, 1

SOURCE INFORMATION

| Source Number: | 1 | 2 |
|---|---|---|
| Source Height (m): | 1.00 | 1.00 |
| Area (sq m): | 16187.00 | 32000.00 |

| 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 | | | |

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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
Jun 21, 2011 08:31 am

Facility: aRc 2010
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Non-Point Release
Source Type: Area
Emission Year: 2010

Comments: aRc 2010 releases
Lower Level and North Field

Dataset Name: arc2010b
Dataset Date: 6/21/2011 8:31:00 AM
Wind File: . C:\Program Files\CAP88-PC30\WndFiles\KAPL2010.WND

ORGAN DOSE EQUIVALENT SUMMARY

| Organ | Selected Individual (mrem/y) |
|---|---|
| Adrenals | 1.94E-04 |
| B Surfac | 9.66E-02 |
| Breasts | 1.90E-04 |
| St Wall | 1.95E-04 |
| ULI Wall | 2.19E-04 |
| Kidneys | 4.62E-04 |
| Lungs | 2.90E-03 |
| Ovaries | 1.29E-03 |
| R Marrow | 5.26E-03 |
| Spleen | 1.94E-04 |
| Thymus | 1.93E-04 |
| Uterus | 1.95E-04 |
| Bld Wall | 1.99E-04 |
| Brain | 1.91E-04 |
| Esophagu | 7.52E-04 |
| SI Wall | 1.97E-04 |
| LLI Wall | 2.92E-04 |
| Liver | 1.94E-02 |
| Muscle | 1.92E-04 |
| Pancreas | 1.95E-04 |
| Skin | 2.31E-04 |
| Testes | 1.31E-03 |
| Thyroid | 1.93E-04 |
| EFFEC | 6.29E-02 |

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

| Pathway | Selected Individual (mrem/y) |
|---|---|
| INGESTION | 2.00E-04 |
| INHALATION | 6.27E-02 |
| AIR IMMERSION | 1.06E-07 |
| GROUND SURFACE | 9.87E-07 |
| INTERNAL | 6.29E-02 |
| EXTERNAL | 1.09E-06 |
| TOTAL | 6.29E-02 |

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

| Nuclide | Selected Individual (mrem/y) |
|---|---|
| Cs-137 | 1.93E-05 |
| Ba-137m | 5.74E-07 |
| Pu-238 | 1.68E-03 |
| U-234 | 1.77E-03 |
| Th-230 | 0.00E+00 |
| Ra-226 | 0.00E+00 |
| Rn-222 | 0.00E+00 |
| Po-218 | 0.00E+00 |
| Pb-214 | 1.19E-06 |
| Bi-214 | 3.62E-07 |
| Po-214 | 3.64E-13 |
| Pb-210 | 0.00E+00 |
| Bi-210 | 0.00E+00 |
| Po-210 | 0.00E+00 |
| At-218 | 0.00E+00 |
| Pu-239 | 2.85E-02 |
| U-235 | 1.03E-04 |
| Th-231 | 4.15E-09 |
| 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 | 2.85E-02 |
| U-236 | 0.00E+00 |
| Th-232 | 0.00E+00 |
| Ra-228 | 0.00E+00 |
| Ac-228 | 0.00E+00 |
| U-238 | 1.82E-04 |
| Th-234 | 2.52E-08 |
| Pa-234m | 2.77E-08 |
| Pa-234 | 0.00E+00 |
| Pb-212 | 1.98E-05 |
| Bi-212 | 2.29E-06 |
| Po-212 | 0.00E+00 |
| Tl-208 | 1.94E-08 |
| Sr-90 | 1.23E-04 |
| Y-90 | 6.85E-07 |
| Pu-241 | 5.07E-04 |
| Am-241 | 1.57E-03 |
| 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 |
| TOTAL | 6.29E-02 |

CANCER RISK SUMMARY

| Cancer | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Esophagu | 2.53E-11 |
| Stomach | 6.29E-11 |
| Colon | 1.50E-10 |
| Liver | 3.56E-09 |
| LUNG | 5.79E-09 |
| Bone | 1.00E-09 |
| Skin | 1.79E-12 |
| Breast | 3.60E-11 |
| Ovary | 2.14E-10 |
| Bladder | 5.92E-11 |
| Kidneys | 3.75E-11 |
| Thyroid | 5.02E-12 |
| Leukemia | 2.38E-10 |
| Residual | 2.19E-10 |
| Total | 1.14E-08 |
| TOTAL | 2.28E-08 |

PATHWAY RISK SUMMARY

| Pathway | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| INGESTION | 8.88E-11 |
| INHALATION | 1.13E-08 |
| AIR IMMERSION | 5.74E-14 |
| GROUND SURFACE | 3.54E-13 |
| INTERNAL | 1.14E-08 |
| EXTERNAL | 4.11E-13 |
| TOTAL | 1.14E-08 |

NUCLIDE RISK SUMMARY

| Nuclide | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Cs-137 | 9.68E-12 |
| Ba-137m | 3.11E-13 |
| Pu-238 | 2.92E-10 |
| U-234 | 1.46E-09 |
| Th-230 | 0.00E+00 |
| Ra-226 | 0.00E+00 |
| Rn-222 | 0.00E+00 |
| Po-218 | 0.00E+00 |
| Pb-214 | 8.14E-13 |
| Bi-214 | 1.85E-13 |
| Po-214 | 2.00E-19 |
| Pb-210 | 0.00E+00 |
| Bi-210 | 0.00E+00 |
| Po-210 | 0.00E+00 |
| At-218 | 0.00E+00 |
| Pu-239 | 4.51E-09 |
| U-235 | 8.58E-11 |
| Th-231 | 1.89E-15 |
| 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 | 4.52E-09 |
| U-236 | 0.00E+00 |
| Th-232 | 0.00E+00 |
| Ra-228 | 0.00E+00 |
| Ac-228 | 0.00E+00 |
| U-238 | 1.51E-10 |
| Th-234 | 3.56E-14 |
| Pa-234m | 4.44E-15 |
| Pa-234 | 0.00E+00 |
| Pb-212 | 1.71E-11 |
| Bi-212 | 1.47E-12 |
| Po-212 | 0.00E+00 |
| Tl-208 | 1.07E-14 |
| Sr-90 | 7.30E-11 |
| Y-90 | 3.64E-13 |
| Pu-241 | 4.32E-11 |
| Am-241 | 2.48E-10 |
| 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 |
| TOTAL | 1.14E-08 |

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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 450 | 550 | 700 | 750 | 775 | 950 | 1000 |
| N | 6.1E-02 | 4.1E-02 | 2.6E-02 | 2.2E-02 | 2.1E-02 | 1.4E-02 | **1.3E-02** |
| NNW | 7.8E-02 | **5.3E-02*** | 3.3E-02 | 2.9E-02 | 2.7E-02 | 1.8E-02 | 1.6E-02 |
| NW | 2.6E-02 | 1.7E-02 | **1.1E-02*** | 9.4E-03 | 8.8E-03 | 5.9E-03 | 5.3E-03 |
| WNW | 1.7E-02 | 1.1E-02 | 7.0E-03 | 6.1E-03 | **5.7E-03*** | 3.8E-03 | 3.4E-03 |
| W | 2.0E-02 | 1.3E-02 | **8.3E-03** | 7.2E-03 | 6.8E-03 | 4.5E-03 | 4.1E-03 |
| WSW | 1.7E-02 | 1.1E-02 | 6.8E-03 | **5.9E-03** | 5.6E-03 | 3.7E-03 | 3.4E-03 |
| SW | **4.6E-02** | 3.1E-02 | 1.9E-02 | 1.7E-02 | 1.6E-02 | 1.1E-02 | 9.6E-03 |
| SSW | **6.3E-02** | 4.2E-02 | 2.6E-02 | 2.3E-02 | 2.1E-02 | 1.4E-02 | 1.3E-02 |
| S | 4.9E-02 | **3.3E-02** | 2.0E-02 | 1.7E-02 | 1.6E-02 | 1.1E-02 | 9.8E-03 |
| SSE | 6.6E-02 | 4.4E-02 | 2.7E-02 | 2.4E-02 | 2.2E-02 | 1.5E-02 | 1.3E-02 |
| SE | 7.8E-02 | 5.2E-02 | 3.3E-02 | 2.8E-02 | 2.7E-02 | 1.8E-02 | 1.6E-02 |
| ESE | 9.5E-02 | 6.5E-02 | 4.1E-02 | 3.6E-02 | 3.4E-02 | 2.3E-02 | **2.1E-02** |
| E | 5.0E-02 | 3.4E-02 | **2.1E-02** | 1.8E-02 | 1.7E-02 | 1.2E-02 | 1.1E-02 |
| ENE | 3.3E-02 | 2.2E-02 | **1.4E-02** | 1.2E-02 | 1.1E-02 | 7.5E-03 | 6.8E-03 |
| NE | 2.9E-02 | 2.0E-02 | **1.2E-02** | 1.1E-02 | 9.9E-03 | 6.6E-03 | 5.9E-03 |
| NNE | 3.3E-02 | 2.2E-02 | 1.4E-02 | 1.2E-02 | 1.1E-02 | **7.4E-03** | 6.7E-03 |

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 |
| N | 1.2E-02 | 8.0E-03 | 5.2E-03 | 2.4E-03 |
| NNW | 1.5E-02 | **1.0E-02** | 6.8E-03 | 3.2E-03 |
| NW | 4.9E-03 | 3.3E-03 | 2.2E-03 | **1.0E-03** |
| WNW | **3.1E-03** | 2.1E-03 | 1.4E-03 | 6.4E-04 |
| W | 3.7E-03 | 2.5E-03 | 1.6E-03 | 7.6E-04 |
| WSW | 3.1E-03 | 2.1E-03 | 1.4E-03 | 6.4E-04 |
| SW | 8.8E-03 | 6.0E-03 | 3.9E-03 | 1.8E-03 |
| SSW | 1.2E-02 | 8.0E-03 | 5.2E-03 | 2.4E-03 |
| S | 8.9E-03 | 6.1E-03 | 4.0E-03 | 1.8E-03 |
| SSE | 1.2E-02 | 8.3E-03 | **5.4E-03** | 2.5E-03 |
| SE | 1.5E-02 | 1.0E-02 | **6.6E-03** | 3.1E-03 |
| ESE | 1.9E-02 | 1.3E-02 | 8.6E-03 | 4.1E-03 |
| E | 9.7E-03 | 6.7E-03 | 4.4E-03 | 2.1E-03 |
| ENE | 6.2E-03 | 4.3E-03 | 2.8E-03 | 1.3E-03 |
| NE | 5.4E-03 | 3.7E-03 | 2.4E-03 | 1.1E-03 |
| NNE | 6.1E-03 | 4.2E-03 | 2.7E-03 | 1.3E-03 |

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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 450 | 550 | 700 | 750 | 775 | 950 | 1000 |
| N | 1.1E-08 | 7.4E-09 | 4.6E-09 | 4.1E-09 | 3.8E-09 | 2.6E-09 | 2.3E-09 |
| NNW | 1.4E-08 | 9.5E-09 | 6.0E-09 | 5.2E-09 | 4.9E-09 | 3.3E-09 | 3.0E-09 |
| NW | 4.8E-09 | 3.2E-09 | 2.0E-09 | 1.7E-09 | 1.6E-09 | 1.1E-09 | 9.7E-10 |
| WNW | 3.1E-09 | 2.1E-09 | 1.3E-09 | 1.1E-09 | 1.0E-09 | 7.0E-10 | 6.3E-10 |
| W | 3.7E-09 | 2.4E-09 | 1.5E-09 | 1.3E-09 | 1.2E-09 | 8.3E-10 | 7.5E-10 |
| WSW | 3.0E-09 | 2.0E-09 | 1.2E-09 | 1.1E-09 | 1.0E-09 | 6.8E-10 | 6.2E-10 |
| SW | 8.4E-09 | 5.6E-09 | 3.5E-09 | 3.1E-09 | 2.9E-09 | 1.9E-09 | 1.7E-09 |
| SSW | 1.1E-08 | 7.7E-09 | 4.7E-09 | 4.1E-09 | 3.9E-09 | 2.6E-09 | 2.3E-09 |
| S | 8.9E-09 | 5.9E-09 | 3.6E-09 | 3.2E-09 | 3.0E-09 | 2.0E-09 | 1.8E-09 |
| SSE | 1.2E-08 | 8.0E-09 | 4.9E-09 | 4.3E-09 | 4.0E-09 | 2.7E-09 | 2.4E-09 |
| SE | 1.4E-08 | 9.5E-09 | 5.9E-09 | 5.2E-09 | 4.8E-09 | 3.2E-09 | 2.9E-09 |
| ESE | 1.7E-08 | 1.2E-08 | 7.4E-09 | 6.5E-09 | 6.1E-09 | 4.1E-09 | 3.7E-09 |
| E | 9.1E-09 | 6.1E-09 | 3.8E-09 | 3.4E-09 | 3.1E-09 | 2.1E-09 | 1.9E-09 |
| ENE | 6.1E-09 | 4.0E-09 | 2.5E-09 | 2.2E-09 | 2.1E-09 | 1.4E-09 | 1.2E-09 |
| NE | 5.3E-09 | 3.5E-09 | 2.2E-09 | 1.9E-09 | 1.8E-09 | 1.2E-09 | 1.1E-09 |
| NNE | 6.0E-09 | 4.0E-09 | 2.5E-09 | 2.1E-09 | 2.0E-09 | 1.3E-09 | 1.2E-09 |

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 |
| N | 2.1E-09 | 1.5E-09 | 9.6E-10 | 4.5E-10 |
| NNW | 2.7E-09 | 1.9E-09 | 1.2E-09 | 5.8E-10 |
| NW | 8.9E-10 | 6.1E-10 | 4.0E-10 | 1.9E-10 |
| WNW | 5.8E-10 | 4.0E-10 | 2.6E-10 | 1.3E-10 |
| W | 6.8E-10 | 4.7E-10 | 3.1E-10 | 1.5E-10 |
| WSW | 5.7E-10 | 3.9E-10 | 2.6E-10 | 1.3E-10 |
| SW | 1.6E-09 | 1.1E-09 | 7.2E-10 | 3.4E-10 |
| SSW | 2.1E-09 | 1.5E-09 | 9.6E-10 | 4.5E-10 |
| S | 1.6E-09 | 1.1E-09 | 7.3E-10 | 3.4E-10 |
| SSE | 2.2E-09 | 1.5E-09 | 9.9E-10 | 4.6E-10 |
| SE | 2.7E-09 | 1.8E-09 | 1.2E-09 | 5.7E-10 |
| ESE | 3.4E-09 | 2.4E-09 | 1.6E-09 | 7.4E-10 |
| E | 1.8E-09 | 1.2E-09 | 8.1E-10 | 3.8E-10 |
| ENE | 1.1E-09 | 7.8E-10 | 5.1E-10 | 2.4E-10 |
| NE | 9.9E-10 | 6.8E-10 | 4.5E-10 | 2.1E-10 |
| NNE | 1.1E-09 | 7.7E-10 | 5.0E-10 | 2.4E-10 |

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
Jun 21, 2011 08:31 am

Facility: aRc 2010
Address: 2425 River Road
City: Niskayuna
State: NY Zip: 12309

Source Category: Non-Point Release
Source Type: Area
Emission Year: 2010

Comments: aRc 2010 releases
Lower Level and North Field

Dataset Name: arc2010b
Dataset Date: 6/21/2011 8:31:00 AM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2010.WND

Jun 21, 2011 08:31 am WEATHER
Page 1

HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G | Wind Freq |
| N | 1.351 | 1.830 | 2.140 | 1.622 | 1.115 | 0.859 | 0.000 | 0.069 |
| NNW | 1.236 | 1.520 | 2.902 | 2.560 | 1.162 | 1.090 | 0.000 | 0.097 |
| NW | 0.886 | 1.741 | 4.373 | 2.625 | 0.982 | 0.855 | 0.000 | 0.030 |
| WNW | 0.823 | 1.026 | 1.052 | 1.312 | 0.772 | 0.808 | 0.000 | 0.024 |
| W | 0.778 | 0.824 | 0.862 | 1.325 | 0.834 | 0.792 | 0.000 | 0.022 |
| WSW | 0.792 | 0.935 | 1.078 | 1.952 | 0.806 | 0.772 | 0.000 | 0.023 |
| SW | 0.899 | 1.508 | 1.758 | 2.569 | 1.448 | 0.929 | 0.000 | 0.069 |
| SSW | 0.899 | 1.587 | 3.410 | 4.172 | 1.782 | 0.917 | 0.000 | 0.054 |
| S | 0.839 | 1.187 | 0.000 | 2.572 | 0.931 | 0.794 | 0.000 | 0.031 |
| SSE | 0.978 | 1.067 | 0.998 | 0.908 | 0.879 | 0.806 | 0.000 | 0.044 |
| SE | 1.134 | 2.062 | 3.069 | 2.317 | 1.039 | 0.866 | 0.000 | 0.079 |
| ESE | 1.344 | 2.900 | 4.286 | 3.796 | 1.498 | 0.938 | 0.000 | 0.279 |
| E | 1.286 | 2.483 | 4.484 | 3.667 | 1.430 | 0.875 | 0.000 | 0.101 |
| ENE | 1.066 | 2.307 | 4.054 | 2.781 | 1.187 | 0.806 | 0.000 | 0.030 |
| NE | 1.027 | 1.952 | 2.679 | 1.130 | 1.007 | 0.797 | 0.000 | 0.023 |
| NNE | 0.948 | 1.826 | 1.539 | 1.221 | 0.965 | 0.789 | 0.000 | 0.026 |

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 1.875 | 2.677 | 3.373 | 2.525 | 1.574 | 1.033 | 0.000 |
| NNW | 1.737 | 2.315 | 4.086 | 3.519 | 1.688 | 1.522 | 0.000 |
| NW | 1.103 | 2.362 | 4.373 | 3.335 | 1.393 | 1.022 | 0.000 |
| WNW | 0.932 | 1.409 | 1.937 | 2.572 | 0.772 | 0.888 | 0.000 |
| W | 0.792 | 0.936 | 1.143 | 1.846 | 0.964 | 0.837 | 0.000 |
| WSW | 0.837 | 1.222 | 1.574 | 3.472 | 0.880 | 0.772 | 0.000 |
| SW | 1.137 | 2.171 | 2.684 | 3.191 | 1.973 | 1.208 | 0.000 |
| SSW | 1.136 | 2.415 | 3.646 | 4.249 | 2.410 | 1.180 | 0.000 |
| S | 0.978 | 1.672 | 0.000 | 2.572 | 1.212 | 0.845 | 0.000 |
| SSE | 1.314 | 1.593 | 1.354 | 1.429 | 1.157 | 0.882 | 0.000 |
| SE | 1.594 | 2.913 | 4.115 | 3.397 | 1.463 | 1.053 | 0.000 |
| ESE | 1.867 | 3.351 | 4.565 | 4.398 | 2.019 | 1.227 | 0.000 |
| E | 1.801 | 3.197 | 4.712 | 4.495 | 1.956 | 1.076 | 0.000 |
| ENE | 1.482 | 2.959 | 4.242 | 3.730 | 1.672 | 0.880 | 0.000 |
| NE | 1.411 | 2.647 | 3.251 | 1.822 | 1.372 | 0.855 | 0.000 |
| NNE | 1.249 | 2.346 | 2.055 | 1.775 | 1.287 | 0.830 | 0.000 |

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 0.1848 | 0.1415 | 0.0348 | 0.1813 | 0.2163 | 0.2414 | 0.0000 |
| NNW | 0.2264 | 0.1073 | 0.0755 | 0.1451 | 0.1344 | 0.3113 | 0.0000 |
| NW | 0.5214 | 0.0344 | 0.0191 | 0.0458 | 0.0765 | 0.3028 | 0.0000 |
| WNW | 0.6465 | 0.0814 | 0.0142 | 0.0092 | 0.0288 | 0.2199 | 0.0000 |
| W | 0.4504 | 0.1151 | 0.0731 | 0.0260 | 0.0471 | 0.2883 | 0.0000 |
| WSW | 0.4021 | 0.0787 | 0.0979 | 0.1861 | 0.0783 | 0.1570 | 0.0000 |
| SW | 0.3378 | 0.1204 | 0.1054 | 0.1120 | 0.1103 | 0.2141 | 0.0000 |
| SSW | 0.3454 | 0.0486 | 0.0105 | 0.0296 | 0.0699 | 0.4960 | 0.0000 |
| S | 0.3506 | 0.0070 | 0.0000 | 0.0035 | 0.0143 | 0.6245 | 0.0000 |
| SSE | 0.2685 | 0.0338 | 0.0077 | 0.0286 | 0.1092 | 0.5521 | 0.0000 |
| SE | 0.1337 | 0.0770 | 0.0756 | 0.2443 | 0.1439 | 0.3255 | 0.0000 |
| ESE | 0.0379 | 0.0848 | 0.2343 | 0.5068 | 0.0630 | 0.0733 | 0.0000 |
| E | 0.0639 | 0.0855 | 0.1679 | 0.4613 | 0.0867 | 0.1347 | 0.0000 |
| ENE | 0.1463 | 0.1077 | 0.0842 | 0.1234 | 0.1536 | 0.3848 | 0.0000 |
| NE | 0.1549 | 0.1152 | 0.0798 | 0.0798 | 0.1348 | 0.4354 | 0.0000 |
| NNE | 0.2188 | 0.0712 | 0.0311 | 0.1117 | 0.1565 | 0.4107 | 0.0000 |
| TOTAL | 0.1909 | 0.0861 | 0.1159 | 0.2590 | 0.0997 | 0.2483 | 0.0000 |

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 10.5 degrees C
283.66 K
Precipitation: 96.1 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: 2.459 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

# ATTACHMENTS A through E

# CAP88-PC OUTPUT REPORTS

# ATTACHMENT A

# CAP88-PC OUTPUT

# SPRU DP 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
Jun 16, 2011 11:21 am

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

Source Category: point sources
Source Type: Stack
Emission Year: 2010

Comments: 2010 compliance report
H2, G2, Tank Farm releases

| Effective Dose Equivalent (mrem/year) |
|---|
| 4.63E-04 |

At This Location: 450 Meters South Southwest

Dataset Name: 2010 Point EDE
Dataset Date: 6/16/2011 11:06:00 AM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2010

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters South Southwest
Lifetime Fatal Cancer Risk: 8.32E-11

RADIONUCLIDE EMISSIONS DURING THE YEAR 2010

| Nuclide | Type | Size | Source #1 Ci/y | TOTAL Ci/y |
|---|---|---|---|---|
| Cs-137 | F | 1 | 1.7E-06 | 1.7E-06 |
| Ba-137m | M | 1 | 1.7E-06 | 1.7E-06 |
| Sr-90 | M | 1 | 3.1E-07 | 3.1E-07 |
| Y-90 | M | 1 | 3.1E-07 | 3.1E-07 |
| Pu-239 | M | 1 | 4.3E-07 | 4.3E-07 |
| Pu-241 | M | 1 | 2.3E-07 | 2.3E-07 |
| Am-241 | M | 1 | 7.0E-08 | 7.0E-08 |

SITE INFORMATION

Temperature: 11 degrees C
Precipitation: 96 cm/y
Humidity: 8 g/cu m
Mixing Height: 1000 m

User specified location of max exposed individual.
(ILOC, JLOC): 8, 1

SOURCE INFORMATION

Source Number: 1

Stack Height (m): 1.00
Diameter (m): 0.30

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 B

# CAP88-PC OUTPUT

# SPRU DP 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
Jun 16, 2011 11:21 am

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

Source Category: point sources
Source Type: Stack
Emission Year: 2010

Comments: 2010 compliance report
H2, G2, Tank Farm releases

Dataset Name: 2010 Point EDE
Dataset Date: 6/16/2011 11:06:00 AM
Wind File: . C:\Program Files\CAP88-PC30\WndFiles\KAPL2010.WND

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

| Pathway | Selected Individual (mrem/y) |
|---|---|
| INGESTION | 3.36E-05 |
| INHALATION | 4.28E-04 |
| AIR IMMERSION | 2.99E-09 |
| GROUND SURFACE | 8.81E-07 |
| INTERNAL | 4.62E-04 |
| EXTERNAL | 8.84E-07 |
| TOTAL | 4.63E-04 |

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

| Nuclide | Selected Individual (mrem/y) |
|---|---|
| Cs-137 | 2.81E-05 |
| Ba-137m | 8.79E-07 |
| Sr-90 | 1.91E-07 |
| Y-90 | 7.49E-09 |
| Pu-239 | 3.79E-04 |
| U-235 | 0.00E+00 |
| Th-231 | 0.00E+00 |
| Pu-241 | 3.59E-06 |
| Am-241 | 5.06E-05 |
| 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 | 4.63E-04 |

CANCER RISK SUMMARY

| Cancer | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Esophagus | 4.75E-13 |
| Stomach | 1.50E-12 |
| Colon | 4.03E-12 |
| Liver | 2.47E-11 |
| LUNG | 3.19E-11 |
| Bone | 7.40E-12 |
| Skin | 3.51E-14 |
| Breast | 1.14E-12 |
| Ovary | 2.02E-12 |
| Bladder | 1.17E-12 |
| Kidneys | 3.96E-13 |
| Thyroid | 1.08E-13 |
| Leukemia | 2.86E-12 |
| Residual | 5.40E-12 |
| Total | 8.32E-11 |
| TOTAL | 1.66E-10 |

PATHWAY RISK SUMMARY

| Pathway | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| INGESTION | 1.50E-11 |
| INHALATION | 6.77E-11 |
| AIR IMMERSION | 1.62E-15 |
| GROUND SURFACE | 4.74E-13 |
| INTERNAL | 8.27E-11 |
| EXTERNAL | 4.75E-13 |
| TOTAL | 8.32E-11 |

NUCLIDE RISK SUMMARY

| Nuclide | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Cs-137 | 1.42E-11 |
| Ba-137m | 4.75E-13 |
| Sr-90 | 1.42E-13 |
| Y-90 | 7.96E-15 |
| Pu-239 | 6.00E-11 |
| U-235 | 0.00E+00 |
| Th-231 | 0.00E+00 |
| Pu-241 | 3.06E-13 |
| Am-241 | 8.00E-12 |
| 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 | 8.32E-11 |

Jun 16, 2011 11:21 am 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 | 4.5E-04 | 3.1E-04 | 1.9E-04 | 1.7E-04 | 1.6E-04 | 1.1E-04 | 9.9E-05 |
| NNW | 5.7E-04 | 3.9E-04* | 2.5E-04 | 2.2E-04 | 2.0E-04 | 1.4E-04 | 1.3E-04 |
| NW | 2.0E-04 | 1.3E-04 | 8.5E-05* | 7.5E-05 | 7.1E-05 | 4.9E-05 | 4.5E-05 |
| WNW | 1.3E-04 | 8.9E-05 | 5.8E-05 | 5.1E-05 | 4.8E-05* | 3.4E-05 | 3.2E-05 |
| W | 1.5E-04 | 1.0E-04 | 6.7E-05 | 5.9E-05 | 5.6E-05 | 3.9E-05 | 3.6E-05 |
| WSW | 1.2E-04 | 8.6E-05 | 5.6E-05 | 5.0E-05 | 4.7E-05 | 3.4E-05 | 3.1E-05 |
| SW | 3.4E-04 | 2.3E-04 | 1.5E-04 | 1.3E-04 | 1.2E-04 | 8.4E-05 | 7.6E-05 |
| SSW | 4.6E-04 | 3.1E-04 | 2.0E-04 | 1.7E-04 | 1.6E-04 | 1.1E-04 | 1.0E-04 |
| S | 3.6E-04 | 2.4E-04 | 1.5E-04 | 1.3E-04 | 1.3E-04 | 8.5E-05 | 7.7E-05 |
| SSE | 4.8E-04 | 3.3E-04 | 2.0E-04 | 1.8E-04 | 1.7E-04 | 1.1E-04 | 1.0E-04 |
| SE | 5.7E-04 | 3.9E-04 | 2.4E-04 | 2.1E-04 | 2.0E-04 | 1.4E-04 | 1.2E-04 |
| ESE | 7.0E-04 | 4.8E-04 | 3.0E-04 | 2.7E-04 | 2.5E-04 | 1.7E-04 | 1.6E-04 |
| E | 3.7E-04 | 2.5E-04 | 1.6E-04 | 1.4E-04 | 1.3E-04 | 9.1E-05 | 8.3E-05 |
| ENE | 2.5E-04 | 1.7E-04 | 1.1E-04 | 9.4E-05 | 8.8E-05 | 6.1E-05 | 5.6E-05 |
| NE | 2.2E-04 | 1.5E-04 | 9.4E-05 | 8.3E-05 | 7.8E-05 | 5.4E-05 | 4.9E-05 |
| NNE | 2.4E-04 | 1.7E-04 | 1.0E-04 | 9.2E-05 | 8.7E-05 | 6.0E-05 | 5.5E-05 |

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 |
| N | 9.1E-05 | 6.5E-05 | 4.5E-05 | 2.4E-05 |
| NNW | 1.2E-04 | 8.2E-05 | 5.6E-05 | 2.9E-05 |
| NW | 4.2E-05 | 3.1E-05 | 2.2E-05 | 1.4E-05 |
| WNW | 2.9E-05 | 2.2E-05 | 1.6E-05 | 1.1E-05 |
| W | 3.3E-05 | 2.5E-05 | 1.8E-05 | 1.2E-05 |
| WSW | 2.9E-05 | 2.2E-05 | 1.6E-05 | 1.1E-05 |
| SW | 7.0E-05 | 5.0E-05 | 3.5E-05 | 2.0E-05 |
| SSW | 9.2E-05 | 6.5E-05 | 4.5E-05 | 2.4E-05 |
| S | 7.1E-05 | 5.1E-05 | 3.5E-05 | 1.9E-05 |
| SSE | 9.5E-05 | 6.7E-05 | 4.6E-05 | 2.4E-05 |
| SE | 1.1E-04 | 8.0E-05 | 5.5E-05 | 2.9E-05 |
| ESE | 1.4E-04 | 1.0E-04 | 7.0E-05 | 3.6E-05 |
| E | 7.7E-05 | 5.5E-05 | 3.8E-05 | 2.1E-05 |
| ENE | 5.1E-05 | 3.7E-05 | 2.7E-05 | 1.6E-05 |
| NE | 4.6E-05 | 3.3E-05 | 2.4E-05 | 1.4E-05 |
| NNE | 5.1E-05 | 3.7E-05 | 2.6E-05 | 1.5E-05 |

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

*Business locations

Jun 16, 2011 11:21 am SUMMARY
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INDIVIDUAL LIFETIME RISK (deaths)
(All Radionuclides and Pathways)

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 450 | 550 | 700 | 750 | 775 | 950 | 1000 |
| N | 8.1E-11 | 5.6E-11 | 3.6E-11 | 3.2E-11 | 3.0E-11 | 2.1E-11 | 1.9E-11 |
| NNW | 1.0E-10 | 7.0E-11 | 4.5E-11 | 4.0E-11 | 3.8E-11 | 2.6E-11 | 2.4E-11 |
| NW | 3.6E-11 | 2.6E-11 | 1.7E-11 | 1.5E-11 | 1.4E-11 | 1.1E-11 | 9.9E-12 |
| WNW | 2.5E-11 | 1.8E-11 | 1.2E-11 | 1.1E-11 | 1.0E-11 | 8.0E-12 | 7.5E-12 |
| W | 2.9E-11 | 2.0E-11 | 1.4E-11 | 1.2E-11 | 1.2E-11 | 8.9E-12 | 8.3E-12 |
| WSW | 2.4E-11 | 1.7E-11 | 1.2E-11 | 1.1E-11 | 1.0E-11 | 7.9E-12 | 7.4E-12 |
| SW | 6.2E-11 | 4.3E-11 | 2.8E-11 | 2.5E-11 | 2.4E-11 | 1.7E-11 | 1.5E-11 |
| SSW | 8.3E-11 | 5.7E-11 | 3.7E-11 | 3.2E-11 | 3.0E-11 | 2.1E-11 | 2.0E-11 |
| S | 6.5E-11 | 4.5E-11 | 2.9E-11 | 2.5E-11 | 2.4E-11 | 1.7E-11 | 1.6E-11 |
| SSE | 8.7E-11 | 5.9E-11 | 3.8E-11 | 3.3E-11 | 3.1E-11 | 2.2E-11 | 2.0E-11 |
| SE | 1.0E-10 | 7.0E-11 | 4.5E-11 | 4.0E-11 | 3.7E-11 | 2.6E-11 | 2.4E-11 |
| ESE | 1.3E-10 | 8.6E-11 | 5.6E-11 | 4.9E-11 | 4.6E-11 | 3.3E-11 | 3.0E-11 |
| E | 6.7E-11 | 4.6E-11 | 3.0E-11 | 2.7E-11 | 2.5E-11 | 1.8E-11 | 1.7E-11 |
| ENE | 4.5E-11 | 3.1E-11 | 2.1E-11 | 1.8E-11 | 1.7E-11 | 1.3E-11 | 1.2E-11 |
| NE | 4.0E-11 | 2.8E-11 | 1.8E-11 | 1.6E-11 | 1.6E-11 | 1.1E-11 | 1.1E-11 |
| NNE | 4.5E-11 | 3.1E-11 | 2.0E-11 | 1.8E-11 | 1.7E-11 | 1.2E-11 | 1.2E-11 |

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 |
| N | 1.8E-11 | 1.3E-11 | 9.8E-12 | 6.2E-12 |
| NNW | 2.2E-11 | 1.6E-11 | 1.2E-11 | 7.2E-12 |
| NW | 9.3E-12 | 7.3E-12 | 5.8E-12 | 4.3E-12 |
| WNW | 7.1E-12 | 5.8E-12 | 4.8E-12 | 3.8E-12 |
| W | 7.8E-12 | 6.3E-12 | 5.2E-12 | 4.0E-12 |
| WSW | 7.0E-12 | 5.8E-12 | 4.8E-12 | 3.8E-12 |
| SW | 1.4E-11 | 1.1E-11 | 8.2E-12 | 5.4E-12 |
| SSW | 1.8E-11 | 1.3E-11 | 9.8E-12 | 6.2E-12 |
| S | 1.4E-11 | 1.1E-11 | 8.1E-12 | 5.3E-12 |
| SSE | 1.9E-11 | 1.4E-11 | 1.0E-11 | 6.2E-12 |
| SE | 2.2E-11 | 1.6E-11 | 1.2E-11 | 7.0E-12 |
| ESE | 2.8E-11 | 2.0E-11 | 1.4E-11 | 8.4E-12 |
| E | 1.6E-11 | 1.2E-11 | 8.7E-12 | 5.7E-12 |
| ENE | 1.1E-11 | 8.5E-12 | 6.6E-12 | 4.7E-12 |
| NE | 1.0E-11 | 7.8E-12 | 6.1E-12 | 4.4E-12 |
| NNE | 1.1E-11 | 8.4E-12 | 6.5E-12 | 4.6E-12 |

# ATTACHMENT C

# CAP88-PC OUTPUT

# SPRU DP 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
Jun 16, 2011 01:40 pm

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

Source Category: Total diffuse sources
Source Type: Area
Emission Year: 2010

Comments: Includes unplanned release

| Effective Dose Equivalent (mrem/year) |
|---|
| 5.30E-02 |

At This Location: 450 Meters South Southwest
Dataset Name: 2010 Diffuse EDE
Dataset Date: 6/16/2011 1:38:00 PM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2010

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 450 Meters South Southwest
Lifetime Fatal Cancer Risk: 1.42E-08

RADIONUCLIDE EMISSIONS DURING THE YEAR 2010

| Nuclide | Type | Size | Source #1 Ci/y | TOTAL Ci/y |
|---|---|---|---|---|
| Cs-137 | F | 1 | 2.3E-05 | 2.3E-05 |
| Ba-137m | M | 1 | 2.3E-05 | 2.3E-05 |
| Pu-239 | M | 1 | 3.9E-05 | 3.9E-05 |
| Pu-241 | M | 1 | 1.8E-05 | 1.8E-05 |
| Am-241 | M | 1 | 6.3E-06 | 6.3E-06 |
| Sr-90 | M | 1 | 4.2E-04 | 4.2E-04 |
| Y-90 | M | 1 | 4.2E-04 | 4.2E-04 |

SITE INFORMATION

Temperature: 11 degrees C
Precipitation: 96 cm/y
Humidity: 8 g/cu m
Mixing Height: 1000 m

User specified location of max exposed individual.
(ILOC, JLOC): 8, 1

SOURCE INFORMATION

Source Number: 1

Source Height (m): 1.00
Area (sq m): 1305.00

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 DP 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
Jun 16, 2011 01:40 pm

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

Source Category: Total diffuse sources
Source Type: Area
Emission Year: 2010

Comments: Includes unplanned release

Dataset Name: 2010 Diffuse EDE
Dataset Date: 6/16/2011 1:38:00 PM
Wind File: . C:\Program Files\CAP88-PC30\WndFiles\KAPL2010.WND

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

| Pathway | Selected Individual (mrem/y) |
|---|---|
| INGESTION | 1.39E-02 |
| INHALATION | 3.90E-02 |
| AIR IMMERSION | 6.59E-08 |
| GROUND SURFACE | 5.63E-05 |
| INTERNAL | 5.29E-02 |
| EXTERNAL | 5.64E-05 |
| TOTAL | 5.30E-02 |

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

| Nuclide | Selected Individual (mrem/y) |
|---|---|
| Cs-137 | 3.80E-04 |
| Ba-137m | 1.19E-05 |
| Pu-239 | 3.44E-02 |
| U-235 | 0.00E+00 |
| Th-231 | 0.00E+00 |
| Pu-241 | 2.86E-04 |
| Am-241 | 4.62E-03 |
| 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 | 1.32E-02 |
| Y-90 | 5.42E-05 |
| TOTAL | 5.30E-02 |

CANCER RISK SUMMARY

| Cancer | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Esophagu | 2.52E-11 |
| Stomach | 8.16E-11 |
| Colon | 1.19E-09 |
| Liver | 2.21E-09 |
| LUNG | 2.92E-09 |
| Bone | 9.45E-10 |
| Skin | 6.14E-12 |
| Breast | 6.01E-11 |
| Ovary | 1.61E-10 |
| Bladder | 7.17E-11 |
| Kidneys | 2.69E-11 |
| Thyroid | 5.89E-12 |
| Leukemia | 6.20E-09 |
| Residual | 2.71E-10 |
| Total | 1.42E-08 |
| TOTAL | 2.84E-08 |

PATHWAY RISK SUMMARY

| Pathway | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| INGESTION | 7.85E-09 |
| INHALATION | 6.32E-09 |
| AIR IMMERSION | 2.68E-14 |
| GROUND SURFACE | 1.18E-11 |
| INTERNAL | 1.42E-08 |
| EXTERNAL | 1.18E-11 |
| TOTAL | 1.42E-08 |

NUCLIDE RISK SUMMARY

| Nuclide | Selected Individual Total Lifetime Fatal Cancer Risk |
|---|---|
| Cs-137 | 1.93E-10 |
| Ba-137m | 6.42E-12 |
| Pu-239 | 5.44E-09 |
| U-235 | 0.00E+00 |
| Th-231 | 0.00E+00 |
| Pu-241 | 2.44E-11 |
| Am-241 | 7.28E-10 |
| 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 | 7.77E-09 |
| Y-90 | 1.66E-11 |
| TOTAL | 1.42E-08 |

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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 450 | 550 | 700 | 750 | 775 | 950 | 1000 |
| N | 5.1E-02 | 3.6E-02 | 2.3E-02 | 2.1E-02 | 1.9E-02 | 1.4E-02 | 1.3E-02 |
| NNW | 6.5E-02 | 4.5E-02* | 2.9E-02 | 2.6E-02 | 2.4E-02 | 1.7E-02 | 1.6E-02 |
| NW | 2.3E-02 | 1.7E-02 | 1.1E-02* | 1.0E-02 | 9.7E-03 | 7.3E-03 | 6.8E-03 |
| WNW | 1.6E-02 | 1.2E-02 | 8.2E-03 | 7.5E-03 | 7.2E-03* | 5.6E-03 | 5.3E-03 |
| W | 1.9E-02 | 1.3E-02 | 9.2E-03 | 8.4E-03 | 8.0E-03 | 6.1E-03 | 5.8E-03 |
| WSW | 1.6E-02 | 1.1E-02 | 8.0E-03 | 7.3E-03 | 7.0E-03 | 5.5E-03 | 5.2E-03 |
| SW | 4.0E-02 | 2.8E-02 | 1.8E-02 | 1.6E-02 | 1.5E-02 | 1.1E-02 | 1.0E-02 |
| SSW | 5.3E-02 | 3.7E-02 | 2.4E-02 | 2.1E-02 | 2.0E-02 | 1.4E-02 | 1.3E-02 |
| S | 4.1E-02 | 2.9E-02 | 1.9E-02 | 1.7E-02 | 1.6E-02 | 1.1E-02 | 1.0E-02 |
| SSE | 5.5E-02 | 3.8E-02 | 2.4E-02 | 2.2E-02 | 2.0E-02 | 1.4E-02 | 1.3E-02 |
| SE | 6.5E-02 | 4.5E-02 | 2.9E-02 | 2.6E-02 | 2.4E-02 | 1.7E-02 | 1.6E-02 |
| ESE | 8.0E-02 | 5.5E-02 | 3.6E-02 | 3.2E-02 | 3.0E-02 | 2.1E-02 | 1.9E-02 |
| E | 4.3E-02 | 3.0E-02 | 2.0E-02 | 1.7E-02 | 1.7E-02 | 1.2E-02 | 1.1E-02 |
| ENE | 2.9E-02 | 2.0E-02 | 1.4E-02 | 1.2E-02 | 1.2E-02 | 8.5E-03 | 7.9E-03 |
| NE | 2.6E-02 | 1.8E-02 | 1.2E-02 | 1.1E-02 | 1.0E-02 | 7.7E-03 | 7.2E-03 |
| NNE | 2.9E-02 | 2.0E-02 | 1.3E-02 | 1.2E-02 | 1.1E-02 | 8.4E-03 | 7.8E-03 |

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 |
| N | 1.2E-02 | 9.0E-03 | 6.8E-03 | 4.4E-03 |
| NNW | 1.5E-02 | 1.1E-02 | 8.0E-03 | 5.1E-03 |
| NW | 6.4E-03 | 5.2E-03 | 4.2E-03 | 3.2E-03 |
| WNW | 5.1E-03 | 4.2E-03 | 3.6E-03 | 3.0E-03 |
| W | 5.5E-03 | 4.5E-03 | 3.8E-03 | 3.0E-03 |
| WSW | 5.0E-03 | 4.2E-03 | 3.6E-03 | 2.9E-03 |
| SW | 9.7E-03 | 7.4E-03 | 5.7E-03 | 4.0E-03 |
| SSW | 1.2E-02 | 9.0E-03 | 6.7E-03 | 4.4E-03 |
| S | 9.7E-03 | 7.4E-03 | 5.6E-03 | 3.9E-03 |
| SSE | 1.2E-02 | 9.2E-03 | 6.8E-03 | 4.5E-03 |
| SE | 1.4E-02 | 1.1E-02 | 7.9E-03 | 5.0E-03 |
| ESE | 1.8E-02 | 1.3E-02 | 9.6E-03 | 5.9E-03 |
| E | 1.0E-02 | 7.9E-03 | 6.0E-03 | 4.1E-03 |
| ENE | 7.4E-03 | 5.9E-03 | 4.7E-03 | 3.5E-03 |
| NE | 6.8E-03 | 5.4E-03 | 4.4E-03 | 3.3E-03 |
| NNE | 7.4E-03 | 5.8E-03 | 4.6E-03 | 3.4E-03 |

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

*Business locations

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

| | Distance (m) | | | | | | |
|---|---|---|---|---|---|---|---|
| Direction | 450 | 550 | 700 | 750 | 775 | 950 | 1000 |
| N | 1.4E-08 | 9.8E-09 | 6.7E-09 | 6.0E-09 | 5.8E-09 | 4.3E-09 | 4.1E-09 |
| NNW | 1.7E-08 | 1.2E-08 | 8.2E-09 | 7.4E-09 | 7.0E-09 | 5.2E-09 | 4.8E-09 |
| NW | 6.8E-09 | 5.0E-09 | 3.7E-09 | 3.4E-09 | 3.3E-09 | 2.7E-09 | 2.5E-09 |
| WNW | 5.0E-09 | 3.8E-09 | 2.9E-09 | 2.7E-09 | 2.6E-09 | 2.2E-09 | 2.2E-09 |
| W | 5.6E-09 | 4.2E-09 | 3.2E-09 | 2.9E-09 | 2.8E-09 | 2.4E-09 | 2.3E-09 |
| WSW | 4.8E-09 | 3.7E-09 | 2.8E-09 | 2.7E-09 | 2.6E-09 | 2.2E-09 | 2.1E-09 |
| SW | 1.1E-08 | 7.9E-09 | 5.5E-09 | 5.0E-09 | 4.8E-09 | 3.7E-09 | 3.5E-09 |
| SSW | 1.4E-08 | 1.0E-08 | 6.8E-09 | 6.1E-09 | 5.8E-09 | 4.4E-09 | 4.1E-09 |
| S | 1.1E-08 | 8.0E-09 | 5.5E-09 | 5.0E-09 | 4.8E-09 | 3.6E-09 | 3.4E-09 |
| SSE | 1.5E-08 | 1.0E-08 | 7.0E-09 | 6.3E-09 | 6.0E-09 | 4.4E-09 | 4.2E-09 |
| SE | 1.7E-08 | 1.2E-08 | 8.1E-09 | 7.3E-09 | 6.9E-09 | 5.1E-09 | 4.8E-09 |
| ESE | 2.1E-08 | 1.5E-08 | 1.0E-08 | 9.0E-09 | 8.5E-09 | 6.3E-09 | 5.8E-09 |
| E | 1.2E-08 | 8.3E-09 | 5.8E-09 | 5.2E-09 | 5.0E-09 | 3.8E-09 | 3.6E-09 |
| ENE | 8.1E-09 | 5.9E-09 | 4.2E-09 | 3.9E-09 | 3.7E-09 | 2.9E-09 | 2.8E-09 |
| NE | 7.3E-09 | 5.4E-09 | 3.9E-09 | 3.5E-09 | 3.4E-09 | 2.7E-09 | 2.6E-09 |
| NNE | 8.0E-09 | 5.9E-09 | 4.2E-09 | 3.8E-09 | 3.7E-09 | 2.9E-09 | 2.8E-09 |

| | Distance (m) | | | |
|---|---|---|---|---|
| Direction | 1050 | 1300 | 1650 | 2550 |
| N | 3.9E-09 | 3.1E-09 | 2.5E-09 | 1.9E-09 |
| NNW | 4.6E-09 | 3.6E-09 | 2.9E-09 | 2.1E-09 |
| NW | 2.4E-09 | 2.1E-09 | 1.9E-09 | 1.6E-09 |
| WNW | 2.1E-09 | 1.9E-09 | 1.7E-09 | 1.5E-09 |
| W | 2.2E-09 | 1.9E-09 | 1.7E-09 | 1.6E-09 |
| WSW | 2.1E-09 | 1.9E-09 | 1.7E-09 | 1.5E-09 |
| SW | 3.3E-09 | 2.7E-09 | 2.3E-09 | 1.8E-09 |
| SSW | 3.9E-09 | 3.1E-09 | 2.5E-09 | 1.9E-09 |
| S | 3.2E-09 | 2.7E-09 | 2.2E-09 | 1.8E-09 |
| SSE | 3.9E-09 | 3.1E-09 | 2.5E-09 | 1.9E-09 |
| SE | 4.5E-09 | 3.5E-09 | 2.8E-09 | 2.1E-09 |
| ESE | 5.5E-09 | 4.2E-09 | 3.3E-09 | 2.3E-09 |
| E | 3.4E-09 | 2.8E-09 | 2.3E-09 | 1.8E-09 |
| ENE | 2.7E-09 | 2.3E-09 | 2.0E-09 | 1.7E-09 |
| NE | 2.5E-09 | 2.2E-09 | 1.9E-09 | 1.6E-09 |
| NNE | 2.7E-09 | 2.3E-09 | 2.0E-09 | 1.6E-09 |

# ATTACHMENT E

# CAP88-PC OUTPUT

# SPRU DP

# Weather Data
# For Point and Diffuse Sources
# for
# 2010

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
Jun 16, 2011 11:21 am

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

Source Category: point sources
Source Type: Stack
Emission Year: 2010

Comments: 2010 compliance report
H2, G2, Tank Farm releases

Dataset Name: 2010 Point EDE
Dataset Date: 6/16/2011 11:06:00 AM
Wind File: C:\Program Files\CAP88-PC30\WndFiles\KAPL2010.WND

Jun 16, 2011 11:21 am WEATHER
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HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G | Wind Freq |
| N | 1.351 | 1.830 | 2.140 | 1.622 | 1.115 | 0.859 | 0.000 | 0.069 |
| NNW | 1.236 | 1.520 | 2.902 | 2.560 | 1.162 | 1.090 | 0.000 | 0.097 |
| NW | 0.886 | 1.741 | 4.373 | 2.625 | 0.982 | 0.855 | 0.000 | 0.030 |
| WNW | 0.823 | 1.026 | 1.052 | 1.312 | 0.772 | 0.808 | 0.000 | 0.024 |
| W | 0.778 | 0.824 | 0.862 | 1.325 | 0.834 | 0.792 | 0.000 | 0.022 |
| WSW | 0.792 | 0.935 | 1.078 | 1.952 | 0.806 | 0.772 | 0.000 | 0.023 |
| SW | 0.899 | 1.508 | 1.758 | 2.569 | 1.448 | 0.929 | 0.000 | 0.069 |
| SSW | 0.899 | 1.587 | 3.410 | 4.172 | 1.782 | 0.917 | 0.000 | 0.054 |
| S | 0.839 | 1.187 | 0.000 | 2.572 | 0.931 | 0.794 | 0.000 | 0.031 |
| SSE | 0.978 | 1.067 | 0.998 | 0.908 | 0.879 | 0.806 | 0.000 | 0.044 |
| SE | 1.134 | 2.062 | 3.069 | 2.317 | 1.039 | 0.866 | 0.000 | 0.079 |
| ESE | 1.344 | 2.900 | 4.286 | 3.796 | 1.498 | 0.938 | 0.000 | 0.279 |
| E | 1.286 | 2.483 | 4.484 | 3.667 | 1.430 | 0.875 | 0.000 | 0.101 |
| ENE | 1.066 | 2.307 | 4.054 | 2.781 | 1.187 | 0.806 | 0.000 | 0.030 |
| NE | 1.027 | 1.952 | 2.679 | 1.130 | 1.007 | 0.797 | 0.000 | 0.023 |
| NNE | 0.948 | 1.826 | 1.539 | 1.221 | 0.965 | 0.789 | 0.000 | 0.026 |

ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 1.875 | 2.677 | 3.373 | 2.525 | 1.574 | 1.033 | 0.000 |
| NNW | 1.737 | 2.315 | 4.086 | 3.519 | 1.688 | 1.522 | 0.000 |
| NW | 1.103 | 2.362 | 4.373 | 3.335 | 1.393 | 1.022 | 0.000 |
| WNW | 0.932 | 1.409 | 1.937 | 2.572 | 0.772 | 0.888 | 0.000 |
| W | 0.792 | 0.936 | 1.143 | 1.846 | 0.964 | 0.837 | 0.000 |
| WSW | 0.837 | 1.222 | 1.574 | 3.472 | 0.880 | 0.772 | 0.000 |
| SW | 1.137 | 2.171 | 2.684 | 3.191 | 1.973 | 1.208 | 0.000 |
| SSW | 1.136 | 2.415 | 3.646 | 4.249 | 2.410 | 1.180 | 0.000 |
| S | 0.978 | 1.672 | 0.000 | 2.572 | 1.212 | 0.845 | 0.000 |
| SSE | 1.314 | 1.593 | 1.354 | 1.429 | 1.157 | 0.882 | 0.000 |
| SE | 1.594 | 2.913 | 4.115 | 3.397 | 1.463 | 1.053 | 0.000 |
| ESE | 1.867 | 3.351 | 4.565 | 4.398 | 2.019 | 1.227 | 0.000 |
| E | 1.801 | 3.197 | 4.712 | 4.495 | 1.956 | 1.076 | 0.000 |
| ENE | 1.482 | 2.959 | 4.242 | 3.730 | 1.672 | 0.880 | 0.000 |
| NE | 1.411 | 2.647 | 3.251 | 1.822 | 1.372 | 0.855 | 0.000 |
| NNE | 1.249 | 2.346 | 2.055 | 1.775 | 1.287 | 0.830 | 0.000 |

FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

| | Pasquill Stability Class | | | | | | |
|---|---|---|---|---|---|---|---|
| Dir | A | B | C | D | E | F | G |
| N | 0.1848 | 0.1415 | 0.0348 | 0.1813 | 0.2163 | 0.2414 | 0.0000 |
| NNW | 0.2264 | 0.1073 | 0.0755 | 0.1451 | 0.1344 | 0.3113 | 0.0000 |
| NW | 0.5214 | 0.0344 | 0.0191 | 0.0458 | 0.0765 | 0.3028 | 0.0000 |
| WNW | 0.6465 | 0.0814 | 0.0142 | 0.0092 | 0.0288 | 0.2199 | 0.0000 |
| W | 0.4504 | 0.1151 | 0.0731 | 0.0260 | 0.0471 | 0.2883 | 0.0000 |
| WSW | 0.4021 | 0.0787 | 0.0979 | 0.1861 | 0.0783 | 0.1570 | 0.0000 |
| SW | 0.3378 | 0.1204 | 0.1054 | 0.1120 | 0.1103 | 0.2141 | 0.0000 |
| SSW | 0.3454 | 0.0486 | 0.0105 | 0.0296 | 0.0699 | 0.4960 | 0.0000 |
| S | 0.3506 | 0.0070 | 0.0000 | 0.0035 | 0.0143 | 0.6245 | 0.0000 |
| SSE | 0.2685 | 0.0338 | 0.0077 | 0.0286 | 0.1092 | 0.5521 | 0.0000 |
| SE | 0.1337 | 0.0770 | 0.0756 | 0.2443 | 0.1439 | 0.3255 | 0.0000 |
| ESE | 0.0379 | 0.0848 | 0.2343 | 0.5068 | 0.0630 | 0.0733 | 0.0000 |
| E | 0.0639 | 0.0855 | 0.1679 | 0.4613 | 0.0867 | 0.1347 | 0.0000 |
| ENE | 0.1463 | 0.1077 | 0.0842 | 0.1234 | 0.1536 | 0.3848 | 0.0000 |
| NE | 0.1549 | 0.1152 | 0.0798 | 0.0798 | 0.1348 | 0.4354 | 0.0000 |
| NNE | 0.2188 | 0.0712 | 0.0311 | 0.1117 | 0.1565 | 0.4107 | 0.0000 |
| TOTAL | 0.1909 | 0.0861 | 0.1159 | 0.2590 | 0.0997 | 0.2483 | 0.0000 |

ADDITIONAL WEATHER INFORMATION

Average Air Temperature: 10.5 degrees C
283.66 K
Precipitation: 96.1 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: 2.459 m/s

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