The Boeing Company
Santa Susana Field Laboratory
5800 Woolsey Canyon Road
Canoga Park, CA 91304-1148

June 13, 2007
In reply refer to SHEA-105622

BOEING

Mr. Thomas Johnson, Jr.
Department of Energy
Santa Susana Field Laboratory
5800 Woolsey Canyon Road
Canoga Park, CA 91304-1148

Subject: NESHAPs Report for 2006

Dear Mr. Johnson:

Enclosed is the National Emission Standards for Hazardous Air Pollutants (NESHAPs) Report for 2006 for the Department of Energy's (DOE) facility at the Santa Susana Field Laboratory (SSFL). The U.S. Environment Protection Agency (EPA) regulates airborne releases of radioactivity from DOE facilities under 40 CFR 61, Subpart H. This document reports the radiochemical analysis results of the effluent samples from all applicable emission sources. It also includes the off-site dose assessment results, which are compared against the EPA standards for compliance demonstration.

During 2006, the only applicable emission source at the DOE facility at SSFL was the operating exhaust stack at the Radioactive Materials Handling Facility (RMHF). The RMHF Pond, once considered a potential area source when it is dry, contained water at all times until it was discontinued in use and remediated during the year. The Pond has been excavated, and the footprint, as well as the backfill has been surveyed to meet the criteria for unrestricted use. Therefore, the RMHF Pond is no longer considered a potential source for airborne releases.

The EPA limit for a DOE site is 10 mrem/yr, as specified in 40 CFR 61, Subpart H. The regulation also specifies that radiation exposure dose to the Maximally Exposed Individual (MEI) be calculated using the EPA's CAP88PC computer model. Using the EPA's methodology, the Effective Dose Equivalent to the MEI from the RMHF exhaust during 2006 was calculated to be 6.0×10^{-8} mrem (6.0×10^{-10} mSv) per year. Compared to the 10 mrem/yr regulatory limit, the potential dose due to this release was negligible.

T. Johnson, Jr.
SHEA-105622
6/13/07

This report includes the Certification Statement to be signed by R. Amar for The Boeing Company, Santa Susana Field Laboratory and by you for the DOE Site Closure Office. The Certification Statements are required for the final report.

If you have any questions or comments on this report, please contact Ning Liu at (818) 466-8762.

BOEING

Sincerely,

Ravnesa C. Amar

R. Amar, Program Manager
DOE Site Closure

RA:NL:je

Enclosure: Radionuclide Air Emissions Annual Report

T. Johnson, Jr.
SHEA-105622
6/13/07

DOEAIR06

U. S. Department of Energy
Radionuclide Air Emissions Annual Report
(under Subpart H of 40 CFR Part 61)
Calendar Year 2006

Site Name: Santa Susana Field Laboratory
(Prepared on May 25, 2007)

Operations Office Information

Office:	Department of Energy
Address:	Santa Susana Field Laboratory 5800 Woolsey Canyon Road Canoga Park, CA 91304-1148
Contact:	Thomas Johnson, Jr.
Phone:	(818) 466-8959

Site Information

Operator:	The Boeing Company Santa Susana Field Laboratory
Address:	5800 Woolsey Canyon Road Canoga Park, CA 91304-1148
Contact:	Ning Liu
Phone:	(818) 466-8762

Section I. Facility Information

Site Description

The Santa Susana Field Laboratory (SSFL) is located at the boundary of Ventura and Los Angeles Counties in southern California, as shown in Figure 1. The site consists of four administrative areas and undeveloped land, with a total area of approximately 2,850 acres. A broad range of energy related research and development (R&D) projects, including nuclear technologies, were conducted in Area IV of the site. All the nuclear R&D operations in Area IV ceased in 1988, and the subsequent efforts have been directed toward decontamination and decommissioning (D&D) of the former nuclear facilities. Area IV has an area of about 290 acres, and Figure 2 shows the arrangement of the site.

The climate at SSFL is generally dry, with variable winds. The site is situated between Simi Valley and San Fernando Valley, and there is no significant agricultural land use within 30 km (19 miles) radius. While the land immediately surrounding Area IV is undeveloped, suburban residential areas are at greater distances.

Source Description

There are two radiological facilities or buildings remaining in Area IV of the SSFL, as shown in Figure 3. The Radioactive Materials Handling Facility (RMHF) is currently used for processing, packaging, and temporary storage of radioactive waste materials, which are eventually shipped off-site to DOE approved disposal facilities. As a result of the waste handling operations at the RMHF, radioactive effluents were released to the atmosphere through a stack in 2006. The effluents were filtered and monitored before released into the atmosphere to ensure compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements. No radioactive liquid effluents were released from the facility.

Building 4024 housed two experimental reactor systems during the 1960s. After the project was terminated, all equipment and fuel were removed from the facility. In 2005, portions of the building were demolished following release for unrestricted use by the State of California, Department of Health Services (DHS). During 2006, no operations in this building resulted in the release of effluents to the atmosphere.

The RMHF Pond (Sump 614) is a collection sump for rainfall runoff from the RMHF. This pond used to be a potential area source, because radioactivity in the sediment might become airborne when the pond is dry and the sediment is exposed to air. In 2006, the pond contained water at all times until it was discontinued in use and remediated during the year. The Pond has been excavated, and the footprint, as well as the backfill has been surveyed to meet the criteria for

unrestricted use. Therefore, the RMHF Pond is no longer considered a potential source for airborne releases.

In 2006, the only applicable radiological emission source for the DOE facility at SSFL was the operating exhaust stack at the RMHF. Air samples from the ventilation stack were analyzed for specific radionuclides, and the results were used for the dose assessment in this report.

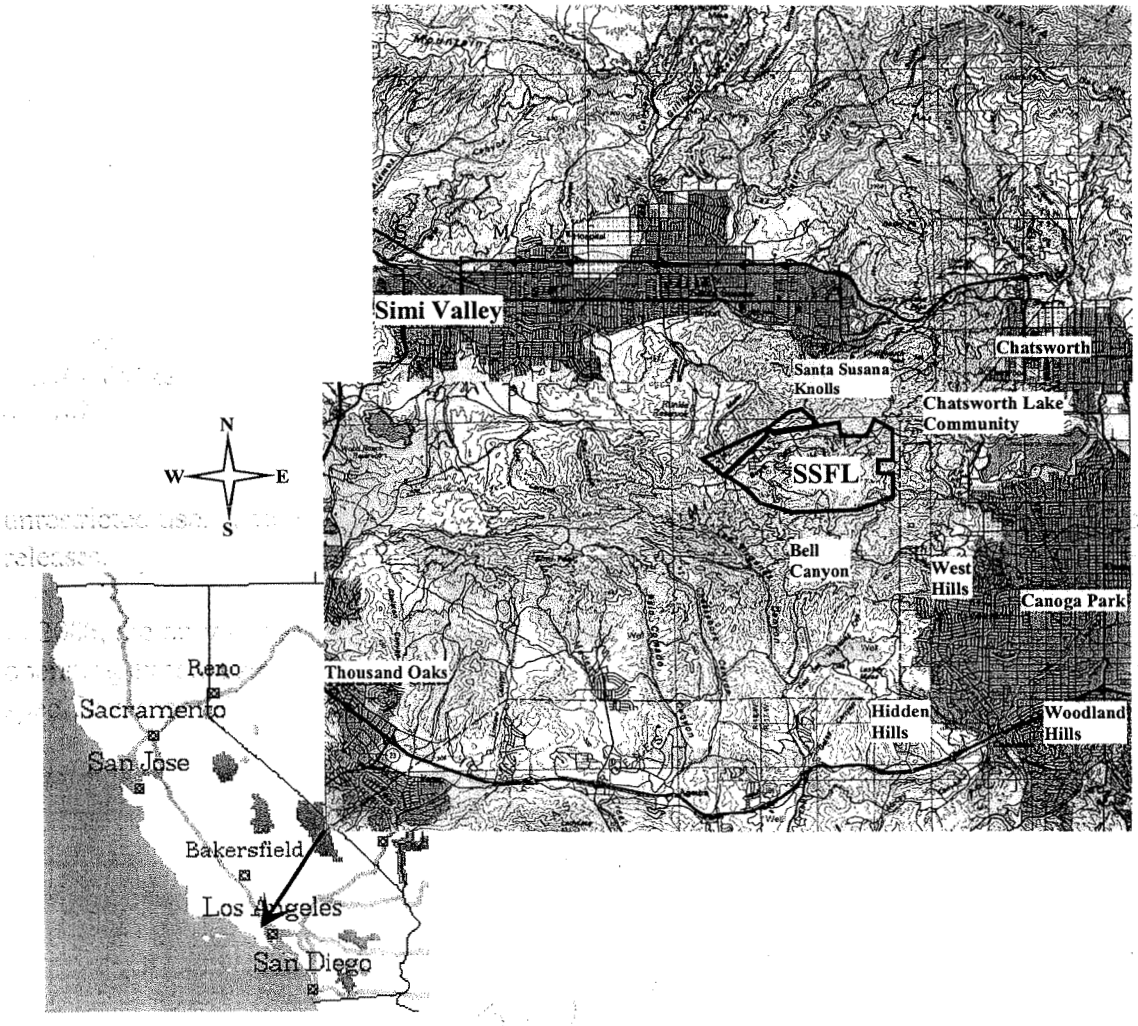

Figure 1. Location of Santa Susana Field Laboratory

Subdivisions			
Owner	**Jurisdiction**	**Acres**	**Subtotals**
The Boeing Co.	Area IV	289.9	
	Area I and III	784.8	
	Undeveloped land	1,324.6	2,399.3
Government	NASA (former AFP 57)	409.5	
	NASA (former AFP 64)	41.7	451.2
Total Acres			2,850.5

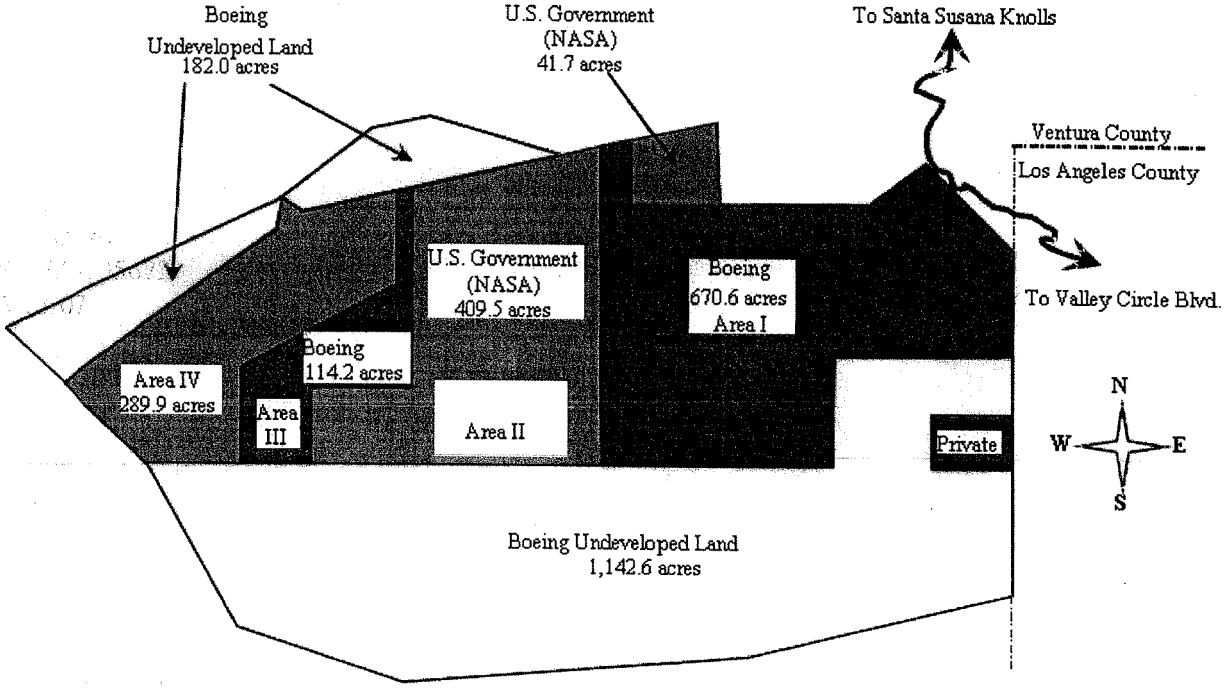

Figure 2. Santa Susana Field Laboratory Site Arrangement

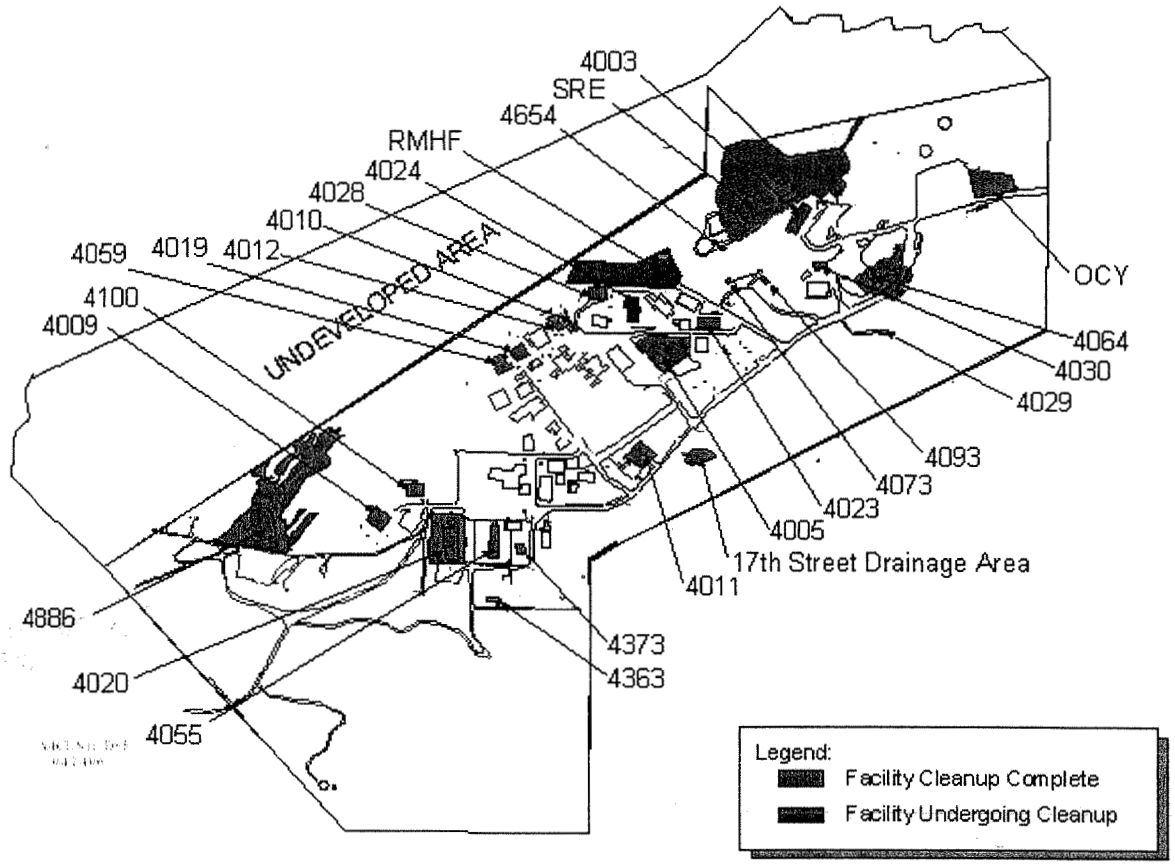

Figure 3. Potential Source Locations in Area IV at Santa Susana Field Laboratory

Section II. Air Emission Data

Point Source

Point Source	Type Control	Efficiency	Location of MEI
RMHF	Pre- and HEPA filters	99.97+%	2,767 m, NW

Point Source Radionuclides	Annual Release Quantity (Ci)	(Bq)
Cs-137	5.26E-07	1.94E+04
Ba-137m	4.97E-07	1.84E+04
U-234	3.31E-09	1.23E+02

Area (Non-Point) Source

N/A

Section III. Dose Assessments

Description of Dose Model

Radiation doses to the Maximally Exposed Individual (MEI) as well as the population in the surrounding area resulting from the emissions of the DOE facility at SSFL during 2006 were calculated using the EPA's CAP88-PC computer code. Site-specific meteorological data, such as wind speed, direction frequency, were used for the atmospheric dispersion calculation in CAP88-PC. Other input data, such as release terms, stack height, and exhaust air velocity, were physically measured to represent the site-specific situation for dose calculations.

Demonstration of compliance with the NESHAPs standard is based on the calculation of the maximum radiation exposure dose to an offsite individual located at a residence, school, business, or office in the vicinity of the SSFL. For this purpose, the nearest such locations have been identified by review of maps, aerial photographs, and direct observations. They are the residential area of Simi Valley, the Brandeis-Bardin Institute, the Santa Monica Mountains Conservancy Sage Ranch office, the residential area in Black Canyon, and the residential area in Bell Canyon. The location with the highest estimated annual dose is considered the location of the Maximally Exposed Individual (MEI).

The RMHF stack was the only emission source in 2006. The Effective Dose Equivalent to the MEI resulting from the emission was compared against the NESHAPs standard for the demonstration of compliance. The dose was calculated using CAP88-PC with site-specific input data.

Compliance Assessment

Based on demographic survey and aerial photographs, three potential locations for the Maximally Exposed Individual (MEI) are identified at 2,043 m south, 2,735 m southeast, or 2,767 m northwest of the RMHF. Calculated exposure dose also depends on meteorological conditions, mostly the predominant wind directions throughout the year. In this analysis, the MEI location is a residence in Simi Valley, 2,767 m NW of the RMHF.

The Effective Dose Equivalent to the MEI from the RMHF exhaust during 2006 was 6.0×10^{-8} mrem (6.0×10^{-10} mSv) per year. The EPA limit for a DOE site is 10 mrem/yr, as specified in 40 CFR 61, Subpart H. This result indicates that the release from the RMHF is negligible when compared to the regulatory limit.

T. Johnson, Jr.
SHEA-105622
6/13/07

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).

Ravnesh C. Amar Date: 6/13/07
R. Amar
Program Manager
DOE Site Closure
Santa Susana Field Laboratory
The Boeing Company

Thomas Q. Johnson Jr. Date: 6/13
T. Johnson, Jr.
Deputy Federal Project Director
Energy Technology Engineering Center
U. S. Department of Energy

T. Johnson, Jr.
SHEA-105622
6/13/07

Supplemental Information

The collective Effective Dose Equivalent resulting from the DOE operations at SSFL during 2006 was calculated to be 1.5×10^{-5} person-rem (1.5×10^{-7} person-Sv).

The population doses were calculated using CAP88-PC in the "POPULATION" mode. The site-specific population distribution was estimated from the demographic survey performed by Claritas Inc. Claritas Inc, a leading demographic survey company, developed the demographic data around SSFL in 2000 based on the census data and modified by direct observations of nearby residential areas around the SSFL site.

No operations regulated by Subparts Q and T were conducted in 2006, nor were there any emissions of Rn-220 from sources containing U-232 and Th-232. There were no non-disposal/non-storage sources of Rn-222 emission.

Potential releases from the RMHF are so low that, even assuming the absence of the HEPA filters, estimated doses would be below the level that requires continuous monitoring as prescribed in 40CFR61.93(b). However, as a good practice, continuous monitoring is still being performed in accordance with ANSI N13.1 standard. The stack effluent at RMHF is continuously sampled, counted for gross alpha and beta activities weekly, and combined annually for radiochemical analysis.

There are four continuous ambient air samplers throughout the SSFL site. The purpose of this monitoring is to ensure that there is no airborne radioactivity resulted from the ongoing decontamination and decommissioning (D&D) activities at the site. Air sampling filters are collected and counted for gross alpha and beta activities on a weekly basis. The weekly samples are combined (separately by location) annually for radiochemical analysis. As usual, the ambient air samples collected in 2006 have radionuclide concentrations far below the Derived Concentration Guide (DCG) values and are generally indistinguishable from offsite background levels. Because the quantities are so close to the detection limits, the variability in the measurements is primarily due to analytical and background variations. The QA program described by Appendix B, Method 114 is implemented for this low-level surveillance effort.

C A P 8 8 - P C

Version 2.10

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 8, 2007 04:01 pm

Facility: RMHF
Address: Santa Susana Field Laboratory
5800 Woolsey Canyon Road
City: Canoga Park
State: CA Zip: 91304

Source Category: DOE facility
Source Type: Stack
Emission Year: 2006

Comments: Individual Dose from RMHF Releases
CY 2006

Effective Dose Equivalent (mrem/year)
6.04E-08

At This Location: 2767 Meters Northwest

Dataset Name: RMF_06IN
Dataset Date: 6/8/2007 4:01:00 PM
Wind File: C:\CAP88_21\WndFiles\SSFL2006.WND

MAXIMALLY EXPOSED INDIVIDUAL

Location Of The Individual: 2767 Meters Northwest
Lifetime Fatal Cancer Risk: 8.43E-13

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Dose Equivalent (mrem/y)
GONADS	2.74E-09
BREAST	3.01E-09
R MAR	2.90E-09
LUNGS	4.81E-07
THYROID	3.15E-09
ENDOST	5.05E-09
RMNDR	3.35E-09
EFFEC	6.04E-08

RADIONUCLIDE EMISSIONS DURING THE YEAR 2006

Nuclide	Class	Size	Source #1 Ci/y	TOTAL Ci/y
CS-137	D	1.00	5.3E-07	5.3E-07
BA-137M	D	1.00	5.0E-07	5.0E-07
U-234	Y	1.00	3.3E-09	3.3E-09

SITE INFORMATION

Temperature:	14 degrees C
Precipitation:	29 cm/y
Humidity:	7 g/cu m
Mixing Height:	746 m

SOURCE INFORMATION

Source Number: 1

Stack Height (m): 40.00
Diameter (m): 1.00

Plume Rise Momentum (m/s): 15.00
(Exit Velocity)

AGRICULTURAL DATA

	Vegetable	Milk	Meat
Fraction Home Produced:	0.020	0.000	0.000
Fraction From Assessment Area:	0.000	0.000	0.000
Fraction Imported:	0.980	1.000	1.000

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

DISTANCES (M) USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

2767

C A P 8 8 - P C

Version 2.10

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 8, 2007 04:01 pm

Facility: RMHF
Address: Santa Susana Field Laboratory
5800 Woolsey Canyon Road
City: Canoga Park
State: CA Zip: 91304

Source Category: DOE facility
Source Type: Stack
Emission Year: 2006

Comments: Individual Dose from RMHF Releases
CY 2006

Dataset Name: RMF_06IN
Dataset Date: 6/8/2007 4:01:00 PM
Wind File: C:\CAP88_21\WndFiles\SSFL2006.WND

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)
GONADS	2.74E-09
BREAST	3.01E-09
R MAR	2.90E-09
LUNGS	4.81E-07
THYROID	3.15E-09
ENDOST	5.05E-09
RMNDR	3.35E-09
EFFEC	6.04E-08

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)
INGESTION	8.29E-10
INHALATION	5.96E-08
AIR IMMERSION	5.81E-13
GROUND SURFACE	6.66E-12
INTERNAL	6.04E-08
EXTERNAL	7.24E-12
TOTAL	6.05E-08

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclide	Selected Individual (mrem/y)
CS-137	2.88E-09
BA-137M	5.85E-13
U-234	5.76E-08
TOTAL	6.05E-08

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk
LEUKEMIA	8.72E-15
BONE	4.92E-16
THYROID	1.43E-15
BREAST	1.17E-14
LUNG	7.81E-13
STOMACH	7.01E-15
BOWEL	2.87E-15
LIVER	1.03E-14
PANCREAS	6.69E-15
URINARY	4.45E-15
OTHER	8.18E-15
TOTAL	8.43E-13

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk
INGESTION	1.98E-14
INHALATION	8.23E-13
AIR IMMERSION	1.39E-17
GROUND SURFACE	1.41E-16
INTERNAL	8.43E-13
EXTERNAL	1.55E-16
TOTAL	8.43E-13

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk
CS-137	7.58E-14
BA-137M	1.40E-17
U-234	7.67E-13
TOTAL	8.43E-13

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

	Distance (m)
Direction	2767
N	7.4E-09
NNW	2.6E-08
NW	6.0E-08
WNW	3.3E-08
W	6.8E-09
WSW	5.1E-09
SW	9.8E-09
SSW	1.5E-08
S	1.4E-08
SSE	2.6E-08
SE	4.8E-08
ESE	4.2E-08
E	2.8E-08
ENE	6.3E-09
NE	4.4E-09
NNE	4.3E-09

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

	Distance (m)
Direction	2767
N	1.0E-13
NNW	3.6E-13
NW	8.4E-13
WNW	4.7E-13
W	9.5E-14
WSW	7.1E-14
SW	1.4E-13
SSW	2.1E-13
S	1.9E-13
SSE	3.7E-13
SE	6.8E-13
ESE	5.8E-13
E	3.9E-13
ENE	8.8E-14
NE	6.2E-14
NNE	6.1E-14

C A P 8 8 - P C

Version 2.10

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 Population Assessment
May 25, 2007 11:31 am

Facility: RMHF
Address: Santa Susana Field Laboratory
5800 Woolsey Canyon Road
City: Canoga Park
State: CA Zip: 91304

Source Category: DOE facility
Source Type: Stack
Emission Year: 2006

Comments: Population Dose from RMHF Releases
CY 2006

Dataset Name: RMHF06PO
Dataset Date: 5/25/2007 11:31:00 AM
Wind File: C:\CAP88_21\Wndfiles\SSFL2006.WND
Population File: C:\CAP88_21\PopFiles\SSFL2000.POP

ORGAN DOSE EQUIVALENT SUMMARY

Organ	Selected Individual (mrem/y)	Collective Population (person-rem/y)
GONADS	3.17E-09	6.79E-07
BREAST	3.48E-09	7.47E-07
R MAR	3.36E-09	7.21E-07
LUNGS	5.57E-07	1.16E-04
THYROID	3.65E-09	7.82E-07
ENDOST	5.85E-09	1.27E-06
RMNDR	3.88E-09	8.32E-07
EFFEC	7.00E-08	1.45E-05

PATHWAY EFFECTIVE DOSE EQUIVALENT SUMMARY

Pathway	Selected Individual (mrem/y)	Collective Population (person-rem/y)
INGESTION	9.60E-10	2.24E-07
INHALATION	6.91E-08	1.43E-05
AIR IMMERSION	1.00E-12	2.55E-12
GROUND SURFACE	7.71E-12	1.80E-09
INTERNAL	7.00E-08	1.45E-05
EXTERNAL	8.71E-12	1.80E-09
TOTAL	7.00E-08	1.45E-05

NUCLIDE EFFECTIVE DOSE EQUIVALENT SUMMARY

Nuclides	Selected Individual (mrem/y)	Collective Population (person-rem/y)
CS-137	3.33E-09	7.13E-07
BA-137M	1.01E-12	2.56E-12
U-234	6.67E-08	1.38E-05
TOTAL	7.00E-08	1.45E-05

CANCER RISK SUMMARY

Cancer	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
LEUKEMIA	1.01E-14	3.06E-11
BONE	5.70E-16	1.74E-12
THYROID	1.65E-15	5.00E-12
BREAST	1.35E-14	4.10E-11
LUNG	9.05E-13	2.65E-09
STOMACH	8.12E-15	2.46E-11
BOWEL	3.32E-15	1.01E-11
LIVER	1.20E-14	3.62E-11
PANCREAS	7.75E-15	2.34E-11
URINARY	5.16E-15	1.57E-11
OTHER	9.48E-15	2.87E-11
TOTAL	9.76E-13	2.87E-09

PATHWAY RISK SUMMARY

Pathway	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
INGESTION	2.29E-14	7.55E-11
INHALATION	9.53E-13	2.79E-09
AIR IMMERSION	2.40E-17	8.61E-16
GROUND SURFACE	1.63E-16	5.38E-13
INTERNAL	9.76E-13	2.87E-09
EXTERNAL	1.87E-16	5.39E-13
TOTAL	9.76E-13	2.87E-09

PATHWAY GENETIC RISK SUMMARY
(Collective Population)

Pathway	Genetic Risk (person-rem/y)
INGESTION	1.87E-07
INHALATION	4.75E-07
AIR IMMERSION	2.52E-12
GROUND SURFACE	9.22E-10
INTERNAL	6.62E-07
EXTERNAL	9.24E-10
TOTAL	6.63E-07

NUCLIDE RISK SUMMARY

Nuclide	Selected Individual Total Lifetime Fatal Cancer Risk	Total Collective Population Fatal Cancer Risk (Deaths/y)
CS-137	8.78E-14	2.66E-10
BA-137M	2.43E-17	8.66E-16
U-234	8.89E-13	2.61E-09
TOTAL	9.76E-13	2.87E-09

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

	Distance (m)						
Direction	800	2400	4000	5600	7200	8800	11200
N	0.0E+00	8.0E-09	5.7E-09	4.5E-09	3.7E-09	3.2E-09	2.5E-09
NNW	0.0E+00	0.0E+00	1.8E-08	1.2E-08	9.6E-09	7.7E-09	0.0E+00
NW	0.0E+00	7.0E-08	4.0E-08	2.7E-08	2.1E-08	1.6E-08	1.2E-08
WNW	0.0E+00	0.0E+00	0.0E+00	1.5E-08	1.1E-08	9.0E-09	6.7E-09
W	0.0E+00	0.0E+00	0.0E+00	2.9E-09	2.3E-09	1.9E-09	1.4E-09
WSW	0.0E+00	0.0E+00	0.0E+00	2.4E-09	1.9E-09	1.5E-09	1.2E-09
SW	0.0E+00	0.0E+00	0.0E+00	4.1E-09	3.1E-09	2.5E-09	1.8E-09
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.8E-09	3.8E-09	2.8E-09
S	0.0E+00	1.6E-08	9.1E-09	0.0E+00	5.0E-09	4.0E-09	3.1E-09
SSE	0.0E+00	0.0E+00	1.6E-08	0.0E+00	7.8E-09	6.2E-09	4.6E-09
SE	0.0E+00	5.8E-08	3.0E-08	2.0E-08	1.5E-08	1.1E-08	8.3E-09
ESE	0.0E+00	4.7E-08	0.0E+00	2.0E-08	1.5E-08	1.2E-08	9.0E-09
E	0.0E+00	0.0E+00	0.0E+00	1.4E-08	1.1E-08	8.9E-09	6.7E-09
ENE	0.0E+00	0.0E+00	0.0E+00	3.7E-09	3.0E-09	2.6E-09	2.0E-09
NE	0.0E+00	4.6E-09	3.5E-09	2.8E-09	2.3E-09	0.0E+00	1.5E-09
NNE	0.0E+00	0.0E+00	3.3E-09	2.6E-09	2.1E-09	0.0E+00	1.4E-09

	Distance (m)					
Direction	14400	19200	25600	34400	48000	68000
N	0.0E+00	1.3E-09	9.1E-10	6.3E-10	3.9E-10	1.9E-10
NNW	0.0E+00	3.0E-09	2.0E-09	0.0E+00	0.0E+00	4.5E-10
NW	8.7E-09	6.0E-09	4.0E-09	2.7E-09	1.6E-09	8.4E-10
WNW	5.0E-09	3.4E-09	2.3E-09	1.6E-09	9.7E-10	5.0E-10
W	1.1E-09	7.8E-10	5.4E-10	3.8E-10	2.4E-10	1.3E-10
WSW	8.8E-10	6.2E-10	4.3E-10	3.0E-10	1.9E-10	1.0E-10
SW	1.3E-09	9.2E-10	6.3E-10	4.3E-10	0.0E+00	0.0E+00
SSW	2.1E-09	1.4E-09	9.8E-10	0.0E+00	0.0E+00	0.0E+00
S	2.3E-09	1.6E-09	1.1E-09	0.0E+00	0.0E+00	0.0E+00
SSE	3.5E-09	2.5E-09	1.7E-09	0.0E+00	7.9E-10	4.5E-10
SE	6.0E-09	4.1E-09	2.7E-09	1.9E-09	1.1E-09	6.1E-10
ESE	6.6E-09	4.5E-09	3.0E-09	2.0E-09	1.2E-09	5.9E-10
E	5.0E-09	3.4E-09	2.3E-09	1.5E-09	9.3E-10	4.5E-10
ENE	1.5E-09	1.1E-09	7.3E-10	5.0E-10	3.1E-10	1.5E-10
NE	1.2E-09	8.2E-10	5.5E-10	3.8E-10	2.3E-10	1.1E-10
NNE	0.0E+00	7.5E-10	5.1E-10	3.5E-10	2.2E-10	1.1E-10

COLLECTIVE EFFECTIVE DOSE EQUIVALENT (person rem/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	800	2400	4000	5600	7200	8800	11200
N	0.0E+00	3.0E-10	1.2E-08	3.2E-08	2.9E-08	1.6E-11	3.5E-11
NNW	0.0E+00	0.0E+00	5.3E-08	1.1E-07	6.4E-08	2.7E-09	0.0E+00
NW	0.0E+00	3.9E-08	2.5E-07	2.6E-07	2.1E-07	3.9E-09	6.0E-11
WNW	0.0E+00	0.0E+00	0.0E+00	1.2E-07	8.6E-08	6.7E-08	7.1E-09
W	0.0E+00	0.0E+00	0.0E+00	9.5E-10	2.6E-09	3.7E-10	1.7E-08
WSW	0.0E+00	0.0E+00	0.0E+00	1.4E-11	1.6E-09	1.1E-09	1.1E-08
SW	0.0E+00	0.0E+00	0.0E+00	1.5E-08	9.6E-09	7.5E-09	2.1E-08
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.0E-08	2.2E-08	1.8E-08
S	0.0E+00	4.9E-09	2.7E-11	0.0E+00	7.4E-09	9.3E-09	1.1E-08
SSE	0.0E+00	0.0E+00	8.9E-09	0.0E+00	1.3E-10	1.9E-08	2.2E-08
SE	0.0E+00	1.1E-08	2.5E-08	2.7E-08	1.2E-07	1.0E-07	1.8E-07
ESE	0.0E+00	9.5E-09	0.0E+00	4.6E-08	1.4E-07	1.6E-07	4.7E-07
E	0.0E+00	0.0E+00	0.0E+00	2.3E-08	3.9E-08	5.1E-08	2.6E-07
ENE	0.0E+00	0.0E+00	0.0E+00	1.0E-09	1.2E-09	6.1E-09	3.8E-08
NE	0.0E+00	5.0E-10	1.2E-09	2.5E-08	5.1E-09	0.0E+00	2.0E-10
NNE	0.0E+00	0.0E+00	2.7E-09	2.1E-08	6.2E-09	0.0E+00	9.1E-11

	Distance (m)					
Direction	14400	19200	25600	34400	48000	68000
N	0.0E+00	2.7E-10	9.4E-10	3.2E-09	1.7E-10	1.7E-10
NNW	0.0E+00	5.1E-09	1.3E-10	0.0E+00	0.0E+00	2.8E-09
NW	4.0E-09	8.4E-10	5.6E-08	2.0E-09	4.2E-10	2.9E-10
WNW	6.5E-08	5.3E-08	1.8E-09	4.7E-08	1.4E-08	1.8E-08
W	2.1E-08	1.1E-08	1.7E-08	1.8E-08	6.6E-08	7.1E-11
WSW	1.8E-08	1.8E-08	5.2E-09	1.3E-09	3.5E-09	2.0E-13
SW	1.8E-08	3.7E-09	5.8E-10	4.6E-11	0.0E+00	0.0E+00
SSW	3.0E-09	9.0E-10	7.0E-09	0.0E+00	0.0E+00	0.0E+00
S	1.6E-09	8.7E-09	3.9E-10	0.0E+00	0.0E+00	0.0E+00
SSE	3.5E-09	1.0E-08	5.1E-09	0.0E+00	1.1E-08	3.1E-08
SE	9.3E-08	2.4E-08	1.1E-07	9.2E-07	1.3E-06	8.9E-07
ESE	2.8E-07	4.1E-07	3.7E-07	9.3E-07	1.9E-06	1.0E-06
E	2.2E-07	4.6E-07	6.6E-07	4.1E-07	2.5E-07	1.3E-07
ENE	2.3E-08	4.9E-08	7.4E-08	3.3E-09	1.1E-09	1.1E-08
NE	7.3E-11	1.3E-08	2.4E-08	2.7E-08	1.6E-09	2.3E-08
NNE	0.0E+00	6.2E-10	8.9E-09	4.1E-09	7.3E-10	2.9E-10

AVERAGE COLLECTIVE GENETIC DOSE EQUIVALENT
(person rem)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	800	2400	4000	5600	7200	8800	11200
N	0.0E+00	4.2E-10	1.6E-08	4.3E-08	3.9E-08	2.1E-11	4.7E-11
NNW	0.0E+00	0.0E+00	7.1E-08	1.4E-07	8.6E-08	3.6E-09	0.0E+00
NW	0.0E+00	5.2E-08	3.4E-07	3.5E-07	2.8E-07	5.3E-09	8.0E-11
WNW	0.0E+00	0.0E+00	0.0E+00	1.7E-07	1.2E-07	9.1E-08	9.6E-09
W	0.0E+00	0.0E+00	0.0E+00	1.3E-09	3.7E-09	5.1E-10	2.5E-08
WSW	0.0E+00	0.0E+00	0.0E+00	2.0E-11	2.2E-09	1.5E-09	1.5E-08
SW	0.0E+00	0.0E+00	0.0E+00	2.0E-08	1.3E-08	1.0E-08	2.8E-08
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.7E-08	2.9E-08	2.5E-08
S	0.0E+00	6.8E-09	3.8E-11	0.0E+00	1.0E-08	1.3E-08	1.5E-08
SSE	0.0E+00	0.0E+00	1.2E-08	0.0E+00	1.8E-10	2.6E-08	3.1E-08
SE	0.0E+00	1.5E-08	3.4E-08	3.7E-08	1.6E-07	1.4E-07	2.5E-07
ESE	0.0E+00	1.3E-08	0.0E+00	6.2E-08	1.9E-07	2.1E-07	6.3E-07
E	0.0E+00	0.0E+00	0.0E+00	3.1E-08	5.2E-08	6.9E-08	3.5E-07
ENE	0.0E+00	0.0E+00	0.0E+00	1.4E-09	1.6E-09	8.3E-09	5.2E-08
NE	0.0E+00	7.1E-10	1.7E-09	3.4E-08	6.9E-09	0.0E+00	2.7E-10
NNE	0.0E+00	0.0E+00	3.7E-09	2.9E-08	8.4E-09	0.0E+00	1.2E-10

	Distance (m)					
Direction	14400	19200	25600	34400	48000	68000
N	0.0E+00	3.7E-10	1.3E-09	4.3E-09	2.3E-10	2.3E-10
NNW	0.0E+00	6.9E-09	1.8E-10	0.0E+00	0.0E+00	3.8E-09
NW	5.4E-09	1.1E-09	7.6E-08	2.7E-09	5.7E-10	4.0E-10
WNW	8.8E-08	7.3E-08	2.5E-09	6.5E-08	2.0E-08	2.5E-08
W	2.9E-08	1.5E-08	2.5E-08	2.5E-08	9.4E-08	1.0E-10
WSW	2.5E-08	2.5E-08	7.2E-09	1.7E-09	4.9E-09	2.9E-13
SW	2.5E-08	5.1E-09	8.1E-10	6.5E-11	0.0E+00	0.0E+00
SSW	4.1E-09	1.2E-09	9.7E-09	0.0E+00	0.0E+00	0.0E+00
S	2.2E-09	1.2E-08	5.4E-10	0.0E+00	0.0E+00	0.0E+00
SSE	5.0E-09	1.5E-08	7.4E-09	0.0E+00	1.6E-08	4.6E-08
SE	1.3E-07	3.3E-08	1.5E-07	1.3E-06	1.8E-06	1.3E-06
ESE	3.8E-07	5.5E-07	5.0E-07	1.3E-06	2.7E-06	1.4E-06
E	2.9E-07	6.2E-07	8.9E-07	5.5E-07	3.4E-07	1.7E-07
ENE	3.1E-08	6.6E-08	1.0E-07	4.5E-09	1.5E-09	1.5E-08
NE	9.8E-11	1.8E-08	3.3E-08	3.6E-08	2.1E-09	3.2E-08
NNE	0.0E+00	8.4E-10	1.2E-08	5.5E-09	9.9E-10	4.0E-10

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

	Distance (m)						
Direction	800	2400	4000	5600	7200	8800	11200
N	0.0E+00	1.1E-13	8.0E-14	6.3E-14	5.2E-14	4.4E-14	3.5E-14
NNW	0.0E+00	0.0E+00	2.5E-13	1.7E-13	1.3E-13	1.1E-13	0.0E+00
NW	0.0E+00	9.8E-13	5.6E-13	3.8E-13	2.9E-13	2.3E-13	1.7E-13
WNW	0.0E+00	0.0E+00	0.0E+00	2.1E-13	1.6E-13	1.3E-13	9.4E-14
W	0.0E+00	0.0E+00	0.0E+00	4.1E-14	3.2E-14	2.7E-14	2.0E-14
WSW	0.0E+00	0.0E+00	0.0E+00	3.3E-14	2.6E-14	2.1E-14	1.6E-14
SW	0.0E+00	0.0E+00	0.0E+00	5.8E-14	4.3E-14	3.4E-14	2.5E-14
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	6.7E-14	5.3E-14	3.9E-14
S	0.0E+00	2.2E-13	1.3E-13	0.0E+00	7.0E-14	5.7E-14	4.3E-14
SSE	0.0E+00	0.0E+00	2.2E-13	0.0E+00	1.1E-13	8.7E-14	6.4E-14
SE	0.0E+00	8.0E-13	4.3E-13	2.8E-13	2.0E-13	1.6E-13	1.2E-13
ESE	0.0E+00	6.6E-13	0.0E+00	2.8E-13	2.1E-13	1.7E-13	1.3E-13
E	0.0E+00	0.0E+00	0.0E+00	2.0E-13	1.5E-13	1.2E-13	9.4E-14
ENE	0.0E+00	0.0E+00	0.0E+00	5.2E-14	4.3E-14	3.6E-14	2.8E-14
NE	0.0E+00	6.5E-14	4.9E-14	3.9E-14	3.2E-14	0.0E+00	2.1E-14
NNE	0.0E+00	0.0E+00	4.6E-14	3.6E-14	2.9E-14	0.0E+00	1.9E-14

	Distance (m)					
Direction	14400	19200	25600	34400	48000	68000
N	0.0E+00	1.9E-14	1.3E-14	8.8E-15	5.4E-15	2.7E-15
NNW	0.0E+00	4.2E-14	2.8E-14	0.0E+00	0.0E+00	6.3E-15
NW	1.2E-13	8.4E-14	5.5E-14	3.7E-14	2.3E-14	1.2E-14
WNW	6.9E-14	4.8E-14	3.2E-14	2.2E-14	1.3E-14	7.0E-15
W	1.5E-14	1.1E-14	7.6E-15	5.3E-15	3.4E-15	1.9E-15
WSW	1.2E-14	8.7E-15	6.0E-15	4.2E-15	2.6E-15	1.4E-15
SW	1.9E-14	1.3E-14	8.8E-15	6.0E-15	0.0E+00	0.0E+00
SSW	2.9E-14	2.0E-14	1.4E-14	0.0E+00	0.0E+00	0.0E+00
S	3.2E-14	2.3E-14	1.6E-14	0.0E+00	0.0E+00	0.0E+00
SSE	4.9E-14	3.5E-14	2.4E-14	0.0E+00	1.1E-14	6.4E-15
SE	8.4E-14	5.8E-14	3.8E-14	2.6E-14	1.6E-14	8.5E-15
ESE	9.2E-14	6.3E-14	4.1E-14	2.8E-14	1.7E-14	8.2E-15
E	6.9E-14	4.8E-14	3.2E-14	2.1E-14	1.3E-14	6.3E-15
ENE	2.1E-14	1.5E-14	1.0E-14	7.0E-15	4.3E-15	2.1E-15
NE	1.6E-14	1.1E-14	7.7E-15	5.3E-15	3.2E-15	1.6E-15
NNE	0.0E+00	1.0E-14	7.1E-15	4.9E-15	3.0E-15	1.5E-15

COLLECTIVE FATAL CANCER RATE (deaths/y)
(All Radionuclides and Pathways)

	Distance (m)						
Direction	800	2400	4000	5600	7200	8800	11200
N	0.0E+00	6.0E-14	2.3E-12	6.3E-12	5.7E-12	3.1E-15	6.9E-15
NNW	0.0E+00	0.0E+00	1.0E-11	2.1E-11	1.3E-11	5.4E-13	0.0E+00
NW	0.0E+00	7.8E-12	5.0E-11	5.2E-11	4.1E-11	7.8E-13	1.2E-14
WNW	0.0E+00	0.0E+00	0.0E+00	2.4E-11	1.7E-11	1.3E-11	1.4E-12
W	0.0E+00	0.0E+00	0.0E+00	1.9E-13	5.2E-13	7.2E-14	3.4E-12
WSW	0.0E+00	0.0E+00	0.0E+00	2.8E-15	3.1E-13	2.2E-13	2.2E-12
SW	0.0E+00	0.0E+00	0.0E+00	2.9E-12	1.9E-12	1.5E-12	4.1E-12
SSW	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.0E-12	4.2E-12	3.6E-12
S	0.0E+00	9.7E-13	5.4E-15	0.0E+00	1.5E-12	1.8E-12	2.2E-12
SSE	0.0E+00	0.0E+00	1.8E-12	0.0E+00	2.5E-14	3.7E-12	4.3E-12
SE	0.0E+00	2.1E-12	5.0E-12	5.3E-12	2.4E-11	2.0E-11	3.6E-11
ESE	0.0E+00	1.9E-12	0.0E+00	9.1E-12	2.8E-11	3.1E-11	9.3E-11
E	0.0E+00	0.0E+00	0.0E+00	4.5E-12	7.6E-12	1.0E-11	5.1E-11
ENE	0.0E+00	0.0E+00	0.0E+00	2.1E-13	2.3E-13	1.2E-12	7.5E-12
NE	0.0E+00	9.9E-14	2.4E-13	4.9E-12	1.0E-12	0.0E+00	3.9E-14
NNE	0.0E+00	0.0E+00	5.3E-13	4.2E-12	1.2E-12	0.0E+00	1.8E-14

	Distance (m)					
Direction	14400	19200	25600	34400	48000	68000
N	0.0E+00	5.4E-14	1.8E-13	6.2E-13	3.3E-14	3.3E-14
NNW	0.0E+00	1.0E-12	2.6E-14	0.0E+00	0.0E+00	5.4E-13
NW	7.9E-13	1.7E-13	1.1E-11	3.9E-13	8.2E-14	5.7E-14
WNW	1.3E-11	1.0E-11	3.6E-13	9.3E-12	2.8E-12	3.5E-12
W	4.1E-12	2.2E-12	3.4E-12	3.5E-12	1.3E-11	1.4E-14
WSW	3.6E-12	3.6E-12	1.0E-12	2.5E-13	7.0E-13	4.0E-17
SW	3.6E-12	7.3E-13	1.1E-13	9.2E-15	0.0E+00	0.0E+00
SSW	5.8E-13	1.8E-13	1.4E-12	0.0E+00	0.0E+00	0.0E+00
S	3.1E-13	1.7E-12	7.7E-14	0.0E+00	0.0E+00	0.0E+00
SSE	6.9E-13	2.1E-12	1.0E-12	0.0E+00	2.1E-12	6.1E-12
SE	1.8E-11	4.7E-12	2.2E-11	1.8E-10	2.5E-10	1.8E-10
ESE	5.5E-11	8.1E-11	7.4E-11	1.8E-10	3.8E-10	2.0E-10
E	4.3E-11	9.1E-11	1.3E-10	8.0E-11	5.0E-11	2.5E-11
ENE	4.6E-12	9.7E-12	1.5E-11	6.6E-13	2.1E-13	2.2E-12
NE	1.4E-14	2.6E-12	4.8E-12	5.2E-12	3.1E-13	4.6E-12
NNE	0.0E+00	1.2E-13	1.7E-12	8.1E-13	1.4E-13	5.8E-14