UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 6, 2000

MEMORANDUM TO: Lloyd Bolling
Office of State and Tribal Programs

THRU: Lidia Roché, Chief
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Materials Safety
and Safeguards

FROM: Leslie C. Fields, Project Manager
Fuel Cycle Licensing Branch
Division of Fuel Cycle Safety
and Safeguards
Office of Nuclear Materials Safety
and Safeguards

SUBJECT: NRC ANALYSIS SUPPORTING HONEYWELL'S REQUEST TO DISPOSE OF SCRAP METAL UNDER 10 CFR 40.13

Attached you will find copies of the dose calculations to support the July 19, 2000, letter sent to Honeywell, confirming that the scrap metal is categorized as "unimportant quantities of source material, " as stated in 10 CFR 40.13. If you need any additional information you may contact me at (301) 425-6267 or e-mail lcf@nrc.gov.

Attachments:
1. Microshield Assessment for Scrap Metal Disposal
2. RESRAD Assessment for Scrap Metal Disposal

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|---|---|---|---|---|---|---|
| NAME | LFields | | PShea | | LRoché | |
| DATE | 10/ /00 | | 10/ /00 | | 10/06/00 | |

# Honeywell Site
## Microshield Assessment for Scrap Metal Disposal

### Microshield Input Parameters

A microshield computer simulation was used to calculate the approximate dose to a truck driver during transport and handling of the scrap metal from the Honeywell site located in Metropolis, IL to Waste Control Specialists (WCS) in Andrews, TX. A detailed description of the analysis is provided below. The maximum dose to the truck driver transporting the material is .025 mrem per shipment. The details of the truck driver scenario were obtained from a similar waste disposal request submitted to NRC by Cabot Corporation on June 7, 2000. Honeywell has agreed to perform actions to verify that the uranium concentration of the material is under 500 ppm described in the July 19, 2000 letter.

| Microshield Parameter | Value | Units |
|---|---|---|
| source material concentration @ 0.05 wt% | 339 total Uranium | pCi/g |
| natural relative isotopic abundance of U | 165.7 U-238<br>165.7 U-234<br>7.6 U-235 | pCi/g |
| scrap metal density | 7.86 | $g/cm^3$ |
| *50% packing efficiency in loaded truck | 3.93 | $g/cm^3$ |
| 50% packing efficiency @3.93 | 6.5 E-4 U-238<br>6.5 E-4 U-234<br>3.0 E-5 U-235 | $microCi/cm^3$ |
| * truck bed dimensions (length, width, height) | 18<br>7.5<br>5 | feet |
| *shielding thickness for steel truck/cab wall | 1/16 | inches |
| *time it takes for loading/maintenance | 5 | hours |
| *time it takes to drive shipment | 28 | hours |
| *time allowed for truck driver to rest | 16 | hours |
| *average receptor distance for loading/maintenance | 3 | feet |
| *average receptor distance for driving | 7 | feet |
| *average receptor distance for resting | 2 | feet |

| | | |
|---|---|---|
| dose from loading | 5.2 E-3 | mrem |
| dose from driving | 6.1 E-3 | mrem |
| dose from sleeping | 1.4 E-2 | mrem |
| total dose to truck driver per load | 2.5 E-2 | mrem |

* Assumptions made to run simulation. Similar assumptions were made in the Cabot June 7, 2000 submittal.

**Conclusions/Findings**

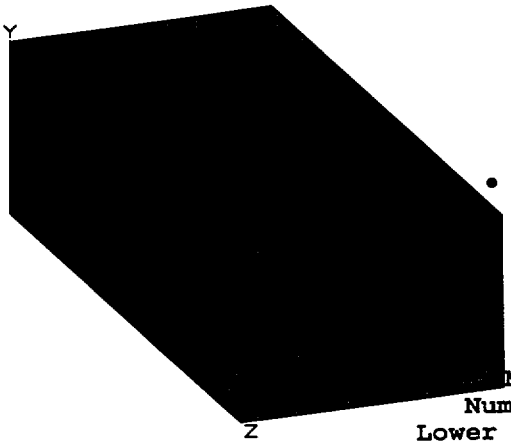
The NRC staff has performed a dose calculation using Microshield computer model to ensure that disposal of this material during transport to the WCS facility would not result in a dose to the public exceeding 25 mrem/yr. The maximum resulting dose, .025 mrem with a total loading and driving time of 49 hours to a truck driver transporting the material from Honeywell site to WCS is significantly less than 25 mrem/yr.

MicroShield v5.05 (5.05-00274)
US NRC

Page : 1
DOS File: HONEY-1.MS5
Run Date: October 5, 2000
Run Time: 4:28:34 PM
Duration: 00:00:11

File Ref: _____
Date: _____
By: _____
Checked: _____

**Case Title: Honeywell - Driver**
**Description: Driver 3 ft from truck side; u238,u234,u235, 50yr decay**
**Geometry: 13 - Rectangular Volume**




**Source Dimensions**

| | | |
|---|---|---|
| Length | 228.6 cm | 7 ft 6.0 in |
| Width | 548.64 cm | 18 ft |
| Height | 152.4 cm | 5 ft 0.0 in |

**Dose Points**

| | X | Y | Z |
|---|---|---|---|
| # 1 | 320.04 cm | 76.2 cm | 274.32 cm |
| | 10 ft 6.0 in | 2 ft 6.0 in | 9 ft |

**Shields**

| Shield Name | Dimension | Material | Density |
|---|---|---|---|
| Source | 675.0 ft³ | Iron | 3.93 |
| Shield 1 | .005 ft | Iron | 7.86 |
| Air Gap | | Air | 0.00122 |

**Source Input**
**Method : Standard Indices**
**Number of Groups : 25**
**Lower Energy Cutoff : 0.015**
**Photons < 0.015 : Excluded**
**Library : Grove**

| Nuclide | curies | becquerels | μCi/cm³ | Bq/cm³ |
|---|---|---|---|---|
| Ac-227 | 3.0294e-007 | 1.1209e+004 | 1.5849e-008 | 5.8643e-004 |
| Bi-210 | 2.2021e-008 | 8.1476e+002 | 1.1521e-009 | 4.2627e-005 |
| Bi-211 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Bi-214 | 6.0071e-008 | 2.2226e+003 | 3.1428e-009 | 1.1628e-004 |
| Fr-223 | 4.1806e-009 | 1.5468e+002 | 2.1872e-010 | 8.0927e-006 |
| Pa-231 | 6.0625e-007 | 2.2431e+004 | 3.1718e-008 | 1.1736e-003 |
| Pa-234 | 1.9878e-005 | 7.3550e+005 | 1.0400e-006 | 3.8480e-002 |
| Pa-234m | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |
| Pb-210 | 2.2044e-008 | 8.1563e+002 | 1.1533e-009 | 4.2672e-005 |
| Pb-211 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Pb-214 | 6.0071e-008 | 2.2226e+003 | 3.1428e-009 | 1.1628e-004 |
| Po-210 | 2.1385e-008 | 7.9125e+002 | 1.1188e-009 | 4.1397e-005 |
| Po-211 | 8.2392e-010 | 3.0485e+001 | 4.3106e-011 | 1.5949e-006 |
| Po-214 | 6.0059e-008 | 2.2222e+003 | 3.1421e-009 | 1.1626e-004 |
| Po-215 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Po-218 | 6.0084e-008 | 2.2231e+003 | 3.1435e-009 | 1.1631e-004 |
| Ra-223 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Ra-226 | 6.0120e-008 | 2.2244e+003 | 3.1453e-009 | 1.1638e-004 |
| Rn-219 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Rn-222 | 6.0084e-008 | 2.2231e+003 | 3.1435e-009 | 1.1631e-004 |
| Th-227 | 2.9806e-007 | 1.1028e+004 | 1.5594e-008 | 5.7697e-004 |
| Th-230 | 5.5907e-006 | 2.0686e+005 | 2.9250e-007 | 1.0822e-002 |
| Th-231 | 5.7342e-004 | 2.1216e+007 | 3.0000e-005 | 1.1100e+000 |
| Th-234 | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |
| Tl-207 | 3.0098e-007 | 1.1136e+004 | 1.5747e-008 | 5.8262e-004 |
| U-234 | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |
| U-235 | 5.7342e-004 | 2.1216e+007 | 3.0000e-005 | 1.1100e+000 |
| U-238 | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |

**Buildup**
**The material reference is : Shield 1**

**Integration Parameters**

| | |
|---|---|
| X Direction | 10 |
| Y Direction | 20 |
| Z Direction | 20 |

**Results**

Page : 2
DOS File: HONEY-1.MS5
Run Date: October 5, 2000
Run Time: 4:28:34 PM
Duration: 00:00:11

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.015 | 3.991e+04 | 0.000e+00 | 7.970e-30 | 0.000e+00 | 6.836e-31 |
| 0.02 | 1.017e+02 | 1.195e-151 | 3.193e-32 | 4.139e-153 | 1.106e-33 |
| 0.03 | 3.111e+06 | 3.694e-49 | 1.341e-27 | 3.661e-51 | 1.329e-29 |
| 0.04 | 9.590e+02 | 4.206e-27 | 5.141e-27 | 1.860e-29 | 2.274e-29 |
| 0.05 | 5.435e+05 | 7.678e-15 | 1.037e-14 | 2.045e-17 | 2.762e-17 |
| 0.06 | 1.809e+07 | 5.783e-09 | 8.656e-09 | 1.149e-11 | 1.719e-11 |
| 0.08 | 3.148e+06 | 4.655e-06 | 8.402e-06 | 7.367e-09 | 1.330e-08 |
| 0.1 | 3.062e+07 | 1.209e-03 | 2.527e-03 | 1.850e-06 | 3.866e-06 |
| 0.15 | 3.538e+06 | 2.449e-03 | 6.256e-03 | 4.032e-06 | 1.030e-05 |
| 0.2 | 1.325e+07 | 2.519e-02 | 7.067e-02 | 4.446e-05 | 1.247e-04 |
| 0.3 | 6.148e+04 | 2.998e-04 | 8.548e-04 | 5.686e-07 | 1.621e-06 |
| 0.4 | 4.892e+04 | 4.091e-04 | 1.121e-03 | 7.970e-07 | 2.185e-06 |
| 0.5 | 6.716e+04 | 8.283e-04 | 2.155e-03 | 1.626e-06 | 4.229e-06 |
| 0.6 | 2.751e+05 | 4.611e-03 | 1.140e-02 | 9.000e-06 | 2.225e-05 |
| 0.8 | 1.527e+06 | 4.111e-02 | 9.346e-02 | 7.820e-05 | 1.778e-04 |
| 1.0 | 4.880e+06 | 1.889e-01 | 4.027e-01 | 3.483e-04 | 7.423e-04 |
| 1.5 | 1.034e+05 | 7.650e-03 | 1.467e-02 | 1.287e-05 | 2.468e-05 |
| 2.0 | 1.387e+04 | 1.593e-03 | 2.888e-03 | 2.463e-06 | 4.466e-06 |
| TOTALS: | 7.932e+07 | 2.743e-01 | 6.087e-01 | 5.041e-04 | 1.118e-03 |

MicroShield v5.05 (5.05-00274)
US NRC
Conversion of calculated exposure in air to dose
FILE: P:\MICROSHI\DATA\HONEY-1.MS5
Case Title: Honeywell - Driver
This case was run on Thursday, October 5, 2000 at 4:28:34 PM
Dose Point # 1 - (10.5,2.5,9) ft

| Results (Summed over energies) | Units | Without Buildup | With Buildup |
|---|---|---|---|
| Photon Fluence Rate (flux) | Photons/cm²/sec | 4.120e-001 | 9.802e-001 |
| Photon Energy Fluence Rate | MeV/cm²/sec | 2.743e-001 | 6.087e-001 |
| Exposure and Dose Rates: | | | |
| Exposure Rate in Air | mR/hr | 5.041e-004 | 1.118e-003 |
| Absorbed Dose Rate in Air | mGy/hr | 4.401e-006 | 9.764e-006 |
| " | mrad/hr | 4.401e-004 | 9.764e-004 |
| Deep Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Parallel Geometry | mSv/hr | 5.182e-006 | 1.156e-005 |
| o Opposed | " | 4.217e-006 | 9.337e-006 |
| o Rotational | " | 4.217e-006 | 9.337e-006 |
| o Isotropic | " | 3.751e-006 | 8.312e-006 |
| Shallow Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Parallel Geometry | mSv/hr | 5.497e-006 | 1.224e-005 |
| o Opposed | " | 5.215e-006 | 1.159e-005 |
| o Rotational | " | 5.215e-006 | 1.159e-005 |
| o Isotropic | " | 4.008e-006 | 8.884e-006 |
| Effective Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Anterior/Posterior Geometry | mSv/hr | 4.621e-006 | 1.030e-005 |
| o Posterior/Anterior | " | 4.139e-006 | 9.194e-006 |
| o Lateral | " | 3.146e-006 | 6.957e-006 |
| o Rotational | " | 3.698e-006 | 8.207e-006 |
| o Isotropic | " | 3.199e-006 | 7.088e-006 |

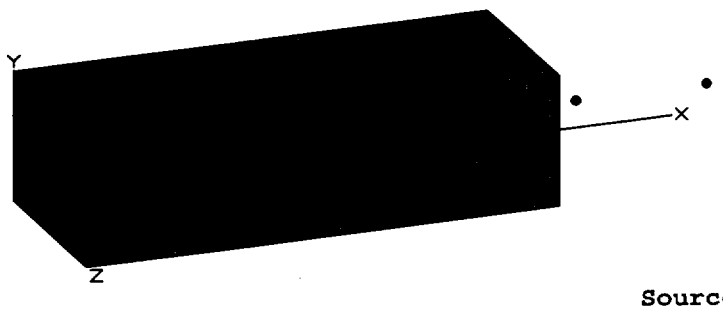
at 3' from side of truck

MicroShield v5.05 (5.05-00274)
US NRC

Page : 1
DOS File: CABOT-2.MS5
Run Date: October 5, 2000
Run Time: 5:09:47 PM
Duration: 00:00:22

File Ref: _____
Date: _____
By: _____
Checked: _____

**Case Title: Cabot - Driver**
**Description: Driver 2ft and 7ft from truck end; u238 series**
**Geometry: 13 - Rectangular Volume**




**Source Dimensions**

| | | |
|---|---|---|
| Length | 548.64 cm | 18 ft |
| Width | 228.6 cm | 7 ft 6.0 in |
| Height | 152.4 cm | 5 ft 0.0 in |

**Dose Points**

| | X | Y | Z |
|---|---|---|---|
| # 1 | 609.6 cm | 76.2 cm | 114.3 cm |
| | 20 ft 0.0 in | 2 ft 6.0 in | 3 ft 9.0 in |
| # 2 | 762 cm | 76.2 cm | 114.3 cm |
| | 25 ft | 2 ft 6.0 in | 3 ft 9.0 in |

**Shields**

| Shield Name | Dimension | Material | Density |
|---|---|---|---|
| Source | 1.91e+07 cm³ | Iron | 3.93 |
| Shield 1 | .317 cm | Iron | 7.86 |
| Air Gap | | Air | 0.00122 |

**Source Input**
**Grouping Method : Standard Indices**
**Number of Groups : 25**
**Lower Energy Cutoff : 0.015**
**Photons < 0.015 : Excluded**
**Library : Grove**

| Nuclide | curies | becquerels | μCi/cm³ | Bq/cm³ |
|---|---|---|---|---|
| Ac-227 | 3.0294e-007 | 1.1209e+004 | 1.5849e-008 | 5.8643e-004 |
| Bi-210 | 2.2021e-008 | 8.1476e+002 | 1.1521e-009 | 4.2627e-005 |
| Bi-211 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Bi-214 | 6.0071e-008 | 2.2226e+003 | 3.1428e-009 | 1.1628e-004 |
| Fr-223 | 4.1806e-009 | 1.5468e+002 | 2.1872e-010 | 8.0927e-006 |
| Pa-231 | 6.0625e-007 | 2.2431e+004 | 3.1718e-008 | 1.1736e-003 |
| Pa-234 | 1.9878e-005 | 7.3550e+005 | 1.0400e-006 | 3.8480e-002 |
| Pa-234m | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |
| Pb-210 | 2.2044e-008 | 8.1563e+002 | 1.1533e-009 | 4.2672e-005 |
| Pb-211 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Pb-214 | 6.0071e-008 | 2.2226e+003 | 3.1428e-009 | 1.1628e-004 |
| Po-210 | 2.1385e-008 | 7.9125e+002 | 1.1188e-009 | 4.1397e-005 |
| Po-211 | 8.2392e-010 | 3.0485e+001 | 4.3106e-011 | 1.5949e-006 |
| Po-214 | 6.0059e-008 | 2.2222e+003 | 3.1421e-009 | 1.1626e-004 |
| Po-215 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Po-218 | 6.0084e-008 | 2.2231e+003 | 3.1435e-009 | 1.1631e-004 |
| Ra-223 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Ra-226 | 6.0120e-008 | 2.2244e+003 | 3.1453e-009 | 1.1638e-004 |
| Rn-219 | 3.0180e-007 | 1.1167e+004 | 1.5790e-008 | 5.8422e-004 |
| Rn-222 | 6.0084e-008 | 2.2231e+003 | 3.1435e-009 | 1.1631e-004 |
| Th-227 | 2.9806e-007 | 1.1028e+004 | 1.5594e-008 | 5.7697e-004 |
| Th-230 | 5.5907e-006 | 2.0686e+005 | 2.9250e-007 | 1.0822e-002 |
| Th-231 | 5.7342e-004 | 2.1216e+007 | 3.0000e-005 | 1.1100e+000 |
| Th-234 | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |
| Tl-207 | 3.0098e-007 | 1.1136e+004 | 1.5747e-008 | 5.8262e-004 |
| U-234 | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |
| U-235 | 5.7342e-004 | 2.1216e+007 | 3.0000e-005 | 1.1100e+000 |
| U-238 | 1.2424e-002 | 4.5969e+008 | 6.5000e-004 | 2.4050e+001 |

**Buildup**
**The material reference is : Shield 1**

**Integration Parameters**

| | |
|---|---|
| X Direction | 10 |
| Y Direction | 20 |
| Z Direction | 20 |

**Results - Dose Point # 1 - (609.6,76.2,114.3) cm**

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.015 | 3.991e+04 | 0.000e+00 | 8.016e-30 | 0.000e+00 | 6.876e-31 |
| 0.02 | 1.017e+02 | 0.000e+00 | 3.212e-32 | 0.000e+00 | 1.113e-33 |
| 0.03 | 3.111e+06 | 6.096e-110 | 1.349e-27 | 6.042e-112 | 1.336e-29 |
| 0.04 | 9.590e+02 | 9.368e-54 | 6.357e-31 | 4.143e-56 | 2.811e-33 |
| 0.05 | 5.435e+05 | 4.890e-29 | 5.728e-28 | 1.303e-31 | 1.526e-30 |
| 0.06 | 1.809e+07 | 1.308e-17 | 2.149e-17 | 2.599e-20 | 4.268e-20 |
| 0.08 | 3.148e+06 | 3.139e-10 | 6.789e-10 | 4.967e-13 | 1.074e-12 |
| 0.1 | 3.062e+07 | 3.531e-06 | 9.660e-06 | 5.401e-09 | 1.478e-08 |
| 0.15 | 3.538e+06 | 1.412e-04 | 5.545e-04 | 2.325e-07 | 9.132e-07 |
| 0.2 | 1.325e+07 | 3.457e-03 | 1.681e-02 | 6.102e-06 | 2.967e-05 |
| 0.3 | 6.148e+04 | 7.745e-05 | 4.109e-04 | 1.469e-07 | 7.794e-07 |
| 0.4 | 4.892e+04 | 1.409e-04 | 7.170e-04 | 2.744e-07 | 1.397e-06 |
| 0.5 | 6.716e+04 | 3.422e-04 | 1.604e-03 | 6.717e-07 | 3.148e-06 |
| 0.6 | 2.751e+05 | 2.174e-03 | 9.342e-03 | 4.243e-06 | 1.823e-05 |
| 0.8 | 1.527e+06 | 2.335e-02 | 8.579e-02 | 4.442e-05 | 1.632e-04 |
| 1.0 | 4.880e+06 | 1.220e-01 | 3.942e-01 | 2.248e-04 | 7.267e-04 |
| 1.5 | 1.034e+05 | 5.974e-03 | 1.542e-02 | 1.005e-05 | 2.594e-05 |
| 2.0 | 1.387e+04 | 1.368e-03 | 3.121e-03 | 2.116e-06 | 4.826e-06 |
| TOTALS: | 7.932e+07 | 1.590e-01 | 5.280e-01 | 2.931e-04 | 9.748e-04 |

**Results - Dose Point # 2 - (762,76.2,114.3) cm**

| Energy MeV | Activity photons/sec | Fluence Rate MeV/cm²/sec No Buildup | Fluence Rate MeV/cm²/sec With Buildup | Exposure Rate mR/hr No Buildup | Exposure Rate mR/hr With Buildup |
|---|---|---|---|---|---|
| 0.015 | 3.991e+04 | 0.000e+00 | 2.447e-30 | 0.000e+00 | 2.099e-31 |
| 0.02 | 1.017e+02 | 0.000e+00 | 9.803e-33 | 0.000e+00 | 3.396e-34 |
| 0.03 | 3.111e+06 | 5.807e-110 | 4.116e-28 | 5.755e-112 | 4.079e-30 |
| 0.04 | 9.590e+02 | 8.943e-54 | 1.940e-31 | 3.955e-56 | 8.581e-34 |
| 0.05 | 5.435e+05 | 4.666e-29 | 2.129e-28 | 1.243e-31 | 5.672e-31 |
| 0.06 | 1.809e+07 | 1.207e-17 | 1.982e-17 | 2.398e-20 | 3.937e-20 |
| 0.08 | 3.148e+06 | 2.488e-10 | 5.364e-10 | 3.938e-13 | 8.488e-13 |
| 0.1 | 3.062e+07 | 2.328e-06 | 6.289e-06 | 3.562e-09 | 9.621e-09 |
| 0.15 | 3.538e+06 | 6.766e-05 | 2.530e-04 | 1.114e-07 | 4.167e-07 |
| 0.2 | 1.325e+07 | 1.425e-03 | 6.347e-03 | 2.515e-06 | 1.120e-05 |
| 0.3 | 6.148e+04 | 2.786e-05 | 1.302e-04 | 5.285e-08 | 2.471e-07 |
| 0.4 | 4.892e+04 | 4.720e-05 | 2.075e-04 | 9.197e-08 | 4.044e-07 |
| 0.5 | 6.716e+04 | 1.092e-04 | 4.392e-04 | 2.144e-07 | 8.622e-07 |
| 0.6 | 2.751e+05 | 6.680e-04 | 2.458e-03 | 1.304e-06 | 4.798e-06 |
| 0.8 | 1.527e+06 | 6.777e-03 | 2.142e-02 | 1.289e-05 | 4.075e-05 |
| 1.0 | 4.880e+06 | 3.390e-02 | 9.508e-02 | 6.249e-05 | 1.753e-04 |
| 1.5 | 1.034e+05 | 1.545e-03 | 3.534e-03 | 2.599e-06 | 5.947e-06 |
| 2.0 | 1.387e+04 | 3.395e-04 | 6.977e-04 | 5.250e-07 | 1.079e-06 |
| TOTALS: | 7.932e+07 | 4.491e-02 | 1.306e-01 | 8.280e-05 | 2.410e-04 |

MicroShield v5.05 (5.05-00274)
US NRC
Conversion of calculated exposure in air to dose
FILE: P:\MICROSHI\DATA\CABOT-2.MS5
Case Title: Cabot - Driver
This case was run on Thursday, October 5, 2000 at 5:09:47 PM
Dose Point # 1 - (609.6,76.2,114.3) cm

| Results (Summed over energies) | Units | Without Buildup | With Buildup |
|---|---|---|---|
| Photon Fluence Rate (flux) | Photons/cm²/sec | 1.790e-001 | 6.231e-001 |
| Photon Energy Fluence Rate | MeV/cm²/sec | 1.590e-001 | 5.280e-001 |
| Exposure and Dose Rates: | | | |
| Exposure Rate in Air | mR/hr | 2.931e-004 | 9.748e-004 |
| Absorbed Dose Rate in Air | mGy/hr | 2.559e-006 | 8.510e-006 |
| " | mrad/hr | 2.559e-004 | 8.510e-004 |
| Deep Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Parallel Geometry | mSv/hr | 2.958e-006 | 9.864e-006 |
| o Opposed | " | 2.467e-006 | 8.193e-006 |
| o Rotational | " | 2.467e-006 | 8.193e-006 |
| o Isotropic | " | 2.189e-006 | 7.270e-006 |
| Shallow Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Parallel Geometry | mSv/hr | 3.157e-006 | 1.052e-005 |
| o Opposed | " | 3.015e-006 | 1.004e-005 |
| o Rotational | " | 3.015e-006 | 1.004e-005 |
| o Isotropic | " | 2.337e-006 | 7.765e-006 |
| Effective Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Anterior/Posterior Geometry | mSv/hr | 2.647e-006 | 8.821e-006 |
| o Posterior/Anterior | " | 2.394e-006 | 7.966e-006 |
| o Lateral | " | 1.845e-006 | 6.122e-006 |
| o Rotational | " | 2.146e-006 | 7.136e-006 |
| o Isotropic | " | 1.866e-006 | 6.198e-006 |

at 2' from end of truck (in cab)

MicroShield v5.05 (5.05-00274)
US NRC
Conversion of calculated exposure in air to dose
FILE: P:\MICROSHI\DATA\CABOT-2.MS5
Case Title: Cabot - Driver
This case was run on Thursday, October 5, 2000 at 5:09:47 PM
Dose Point # 2 - (762,76.2,114.3) cm

| Results (Summed over energies) | Units | Without Buildup | With Buildup |
|---|---|---|---|
| Photon Fluence Rate (flux) | Photons/cm²/sec | 5.271e-002 | 1.640e-001 |
| Photon Energy Fluence Rate | MeV/cm²/sec | 4.491e-002 | 1.306e-001 |
| Exposure and Dose Rates: | | | |
| Exposure Rate in Air | mR/hr | 8.280e-005 | 2.410e-004 |
| Absorbed Dose Rate in Air | mGy/hr | 7.228e-007 | 2.104e-006 |
| " | mrad/hr | 7.228e-005 | 2.104e-004 |
| Deep Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Parallel Geometry | mSv/hr | 8.375e-007 | 2.448e-006 |
| o Opposed | " | 6.962e-007 | 2.023e-006 |
| o Rotational | " | 6.962e-007 | 2.023e-006 |
| o Isotropic | " | 6.179e-007 | 1.796e-006 |
| Shallow Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Parallel Geometry | mSv/hr | 8.933e-007 | 2.607e-006 |
| o Opposed | " | 8.523e-007 | 2.484e-006 |
| o Rotational | " | 8.523e-007 | 2.484e-006 |
| o Isotropic | " | 6.598e-007 | 1.918e-006 |
| Effective Dose Equivalent Rate | (ICRP 51 - 1987) | | |
| o Anterior/Posterior Geometry | mSv/hr | 7.491e-007 | 2.187e-006 |
| o Posterior/Anterior | " | 6.768e-007 | 1.971e-006 |
| o Lateral | " | 5.205e-007 | 1.510e-006 |
| o Rotational | " | 6.063e-007 | 1.765e-006 |
| o Isotropic | " | 5.268e-007 | 1.531e-006 |

at 7' from end of truck (in cab)

# Honeywell Site
## RESRAD Assessment for Scrap Metal Disposal

### Introduction

Honeywell International, Inc. requested (letter dated May 25, 2000) to transfer approximately 90,000 cubic feet (2520 $m^3$ ) of scrap metal, under 10 CFR 40.13, "Unimportant Quantities of Source Material," to Waste Control Specialists Inc. (WCS), in Texas. The scrap metal contains source material at an average uranium concentration of 500 ppm (339 pCi/gm).

### RESRAD Input Parameters

A computer simulation was used to calculate the approximate dose to an individual who resides on the WCS land in the future. The input parameters for RESRAD were those provided in Policy and Guidance Directive PG-8-08 for the resident farmer scenario, except for certain site specific parameters described below. This scenario represents a conservative prediction of the land use after site closure. The resident farmer scenario assumes that a farmer lives on the land and 50% of the resident's grain, vegetable and fruit diet is assumed to be produced from the garden. The scenario also assumes that all of the resident's milk and 50% of the resident's meat diet are produced on site. It assumes produce is irrigated with water drawn from a well at the site boundary, immediately downgradient of the contaminated area. Well water is also used to water the livestock on site. All of the resident's drinking water is produced from the well on site. This scenario is conservative considering that the future use of this land will probably not be a resident farmer. However, the model assumes that the contaminated material is soil. Although the actual material to be disposed of is contaminated scrap metal, the RESRAD model is limited to doses from contaminated soil. The maximum dose to the resident farmer derived from this scenario was calculated to be $3.39 \times 10^{-2}$ mrem/yr at 16,000 years. The site specific parameters were obtained from a submittal to the NRC dated June 7, 2000 from Cabot. The Cabot submittal contains a detailed description of the WCS facility.

| RESRAD parameter | Value | Units |
|---|---|---|
| soil concentration | 339 U-238 | pCi/g |
| area of contaminated zone | 1300 | $m^3$ |
| thickness of contaminated zone | 2 | m |
| cover depth | 5 | m |
| density of cover material | 2.35 | $g/cm^3$ |
| cover depth erosion rate | 1.83E-6 | m/yr |
| evapotranspiration coefficient | 0.8 | |
| precipitation | 0.355 | m/yr |
| irrigation | 0.00 | m/yr |

| | | |
|---|---|---|
| runoff coefficient | 0.05 | |
| unsaturated zone thickness | 300 | m |
| unsaturated zone soil density | 2.35 | $g/cm^3$ |
| unsaturated zone effective porosity | 6.00E-02 | |
| hydraulic conductivity | 1.00E-03 | m/yr |
| total porosity of the cover material | 4.27E-01 | |
| volumetric water content of the cover material | 4.18E-01 | |

## Conclusions/Findings

The NRC staff has performed a dose calculation using the RESRAD computer model to ensure that disposal of this material at the WCS facility would not result in a dose to the public exceeding 25 mrem/yr. The conservative resident farmer scenario, using hydrogeologic parameters specific to the WCS facility, was analyzed. The maximum resulting dose, $3.39 \times 10^{-2}$ mrem/yr at 16,000 years, was significantly less than 25 mrem/yr.

## References

U.S. Nuclear Regulatory Commission, Policy and Guidance Directive PG-8-08, Scenarios for Assessing Potential Doses Associated with Residual Radioactivity, May 1994.

Letter from J. William Lessig (Honeywell Plant Manager) to the NRC dated May 25, 2000, Subject: Radioactive Waste Burial Scrap Metal Less than 0.05% by Weight.

Letter from Timothy Knapp (Cabot Radiation Safety Officer) to the NRC dated June 7, 2000, Re: License SMB-920.

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Contaminated Zone Dimensions
Area: 1300.00 square meters
Thickness: 2.00 meters
Cover Depth: 5.00 meters

Initial Soil Concentrations, pCi/g
U-238 3.390E+02

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 30 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

| t (years): | 0.000E+00 | 1.000E+00 | 3.000E+00 | 1.000E+01 | 3.000E+01 | 1.000E+02 | 1.003E+03 | 1.011E+04 | 1.000E+05 |
|---|---|---|---|---|---|---|---|---|---|
| TDOSE(t): | 0.000E+00 | 7.662E-13 | 2.067E-11 | 7.636E-10 | 2.046E-08 | 7.373E-07 | 5.267E-04 | 3.090E-02 | 1.851E-02 |
| M(t): | 0.000E+00 | 2.554E-14 | 6.891E-13 | 2.545E-11 | 6.819E-10 | 2.458E-08 | 1.756E-05 | 1.030E-03 | 6.172E-04 |

Maximum TDOSE(t): 3.388E-02 mrem/yr at t = 16029 ñ * years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.603E+04 years

Water Independent Pathways (Inhalation excludes radon)

| Radio- Nuclide | Ground mrem/yr | fract. | Inhalation mrem/yr | fract. | Radon mrem/yr | fract. | Plant mrem/yr | fract. | Meat mrem/yr | fract. | Milk mrem/yr | fract. | Soil mrem/yr | fra |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U-238 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.388E-02 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+ | |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.388E-02 | 1.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+( | |

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.603E+04 years

Water Dependent Pathways

| Radio- Nuclide | Water mrem/yr | fract. | Fish mrem/yr | fract. | Radon mrem/yr | fract. | Plant mrem/yr | fract. | Meat mrem/yr | fract. | Milk mrem/yr | fract. | All Pathways* mrem/yr | fra |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| U-238 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.388E- | |
| Total | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 0.000E+00 | 0.0000 | 3.388E-( | |

*Sum of all water independent and dependent pathways.